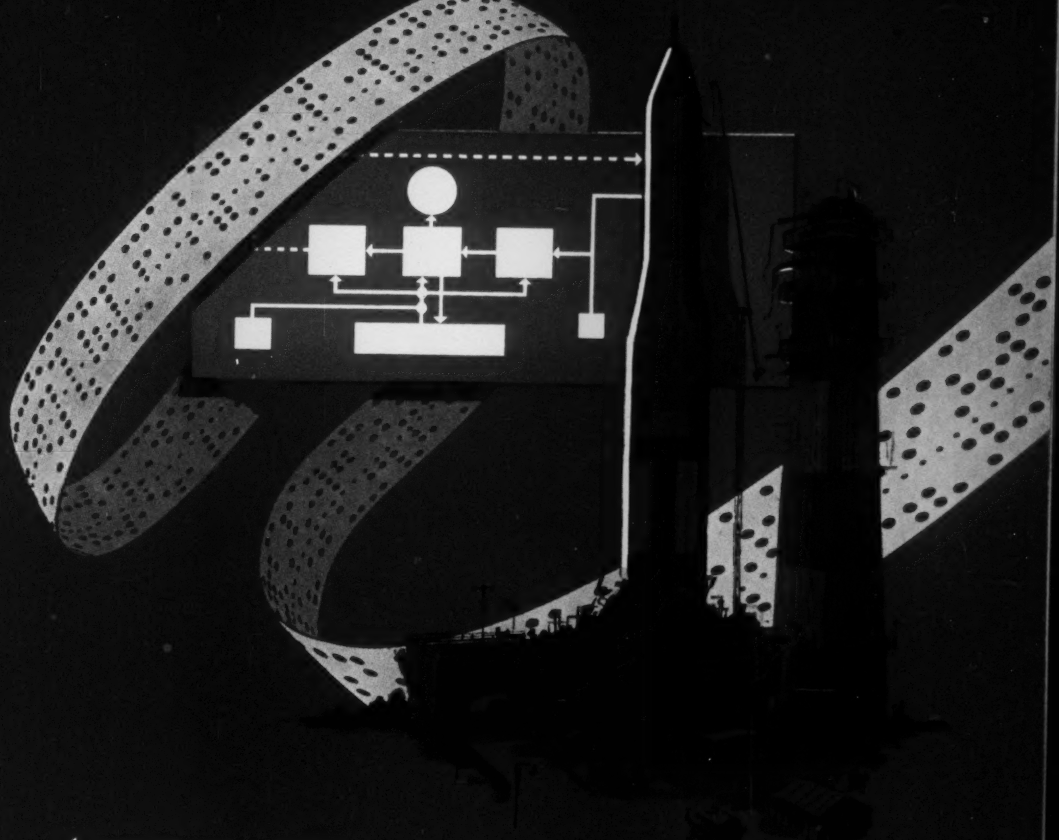
AUTOMATION

SEPTEMBER 1959



Automatic Systems Testing

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- **Manufacturing Engineering**
- **Strip Speed and Tension Regulation**
- **Automated Maintenance Shop**
- **Static Control . . . An Application Appraisal**

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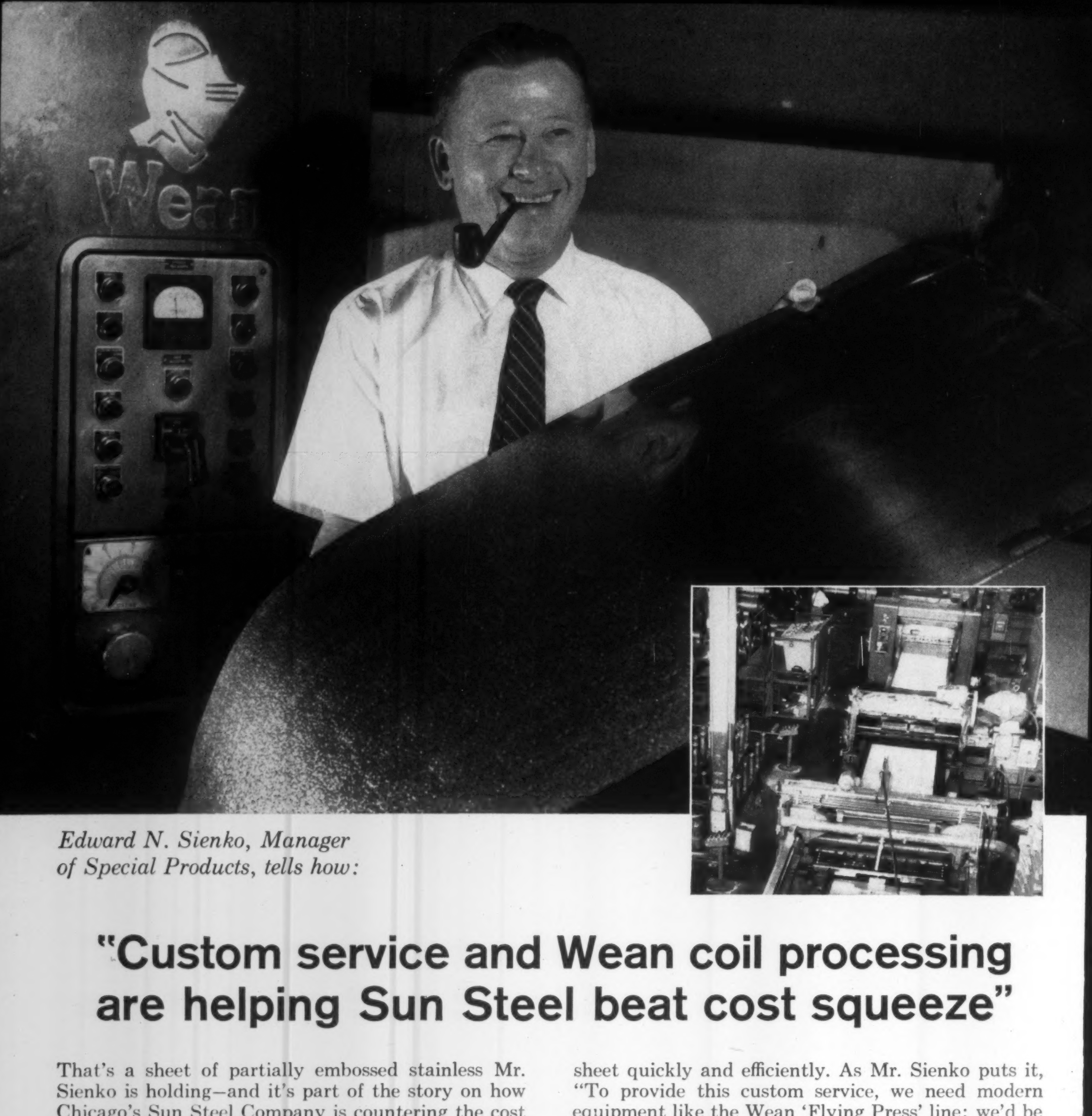
A PENTON PUBLICATION



Edward N. Sienko, Manager of Special Products, tells how:

"Custom service and Wean coil processing are helping Sun Steel beat cost squeeze"

That's a sheet of partially embossed stainless Mr. Sienko is holding—and it's part of the story on how Chicago's Sun Steel Company is countering the cost squeeze on steel warehousing operations.

As Mr. Sienko states it, "Today our margin on materials is half what it was 15 years ago but our man-hour costs are more than double." Sun's answer: add specialty products to better serve customers—such as vinyl-coated steel, embossed stainless and aluminum sheet—and cut costs by installing a Wean coil processing line.

The Wean "Flying Press" line enables Sun to stock standard coils—with savings in cost, handling and inventory—yet meet customer requirements for prime sheet quickly and efficiently. As Mr. Sienko puts it, "To provide this custom service, we need modern equipment like the Wean 'Flying Press' line: we'd be lost without it."

If your firm uses sheet stock in quantity, you should explore the possible economies of coil processing. Write or call for an appointment with an experienced Wean sales engineer: it may be the most important step you'll take this year in the battle against costs.

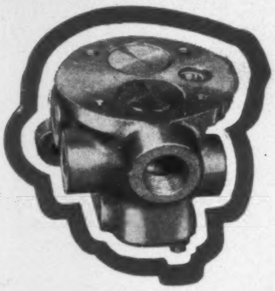
WEAN EQUIPMENT CORPORATION
CLEVELAND 17, OHIO
Detroit • Chicago • Newark

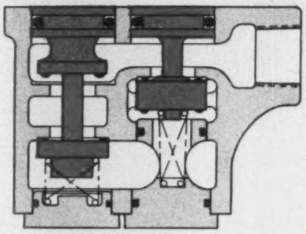
WEAN

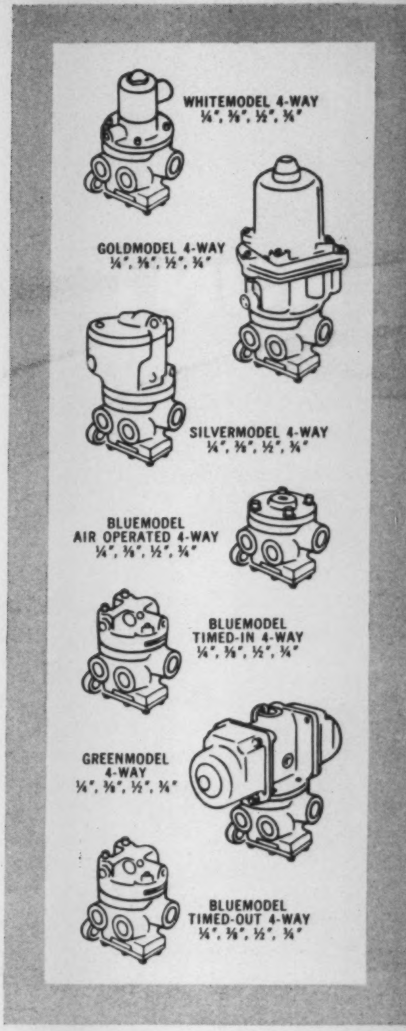
Circle 651 on Page 19

a basic Ross valve building block

4-way inline mounted valve body



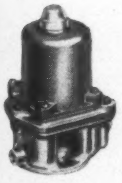


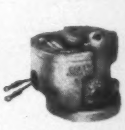

WHITEMODEL 4-WAY
¼", ⅜", ½", ¾"
GOLDMODEL 4-WAY
¼", ⅜", ½", ¾"
SILVERMODEL 4-WAY
¼", ⅜", ½", ¾"
BLUEMODEL AIR OPERATED 4-WAY
¼", ⅜", ½", ¾"
BLUEMODEL TIMED-IN 4-WAY
¼", ⅜", ½", ¾"
GREENMODEL 4-WAY
¼", ⅜", ½", ¾"
BLUEMODEL TIMED-OUT 4-WAY
¼", ⅜", ½", ¾"

- **Compact—saves space**
- **Ross quality**
- **Costs much less than base mounted 4-way**

Lots of designers use this valve where they must save space. It was designed specifically for compactness! Others use it to save money *without sacrificing* quality—when J.I.C. allows the usage of an inline valve, it meets J.I.C. specs. It's a unit of the Ross Skyline series which features modular construction, so it can be actuated with any Skyline series head. Ross poppet construction means pressure assists the seal, and short poppet travel gives faster response. On most applications it outlives the machine—and frequently doesn't even require maintenance. Write for Bulletin 321.

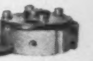
* WHITEMODEL SPOOL SOLENOID


* GOLDMODEL OIL-IMMERSED SOLENOID


* SILVERMODEL JIC SPOOL SOLENOID

GREENMODEL DOUBLE SOLENOID MOMENTARY

BLUEMODEL AIR OPERATED


BLUEMODEL AIR-OPERATED MOMENTARY ADAPTOR

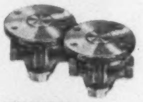
BLUEMODEL AIR-OPERATED TIMED IN

BLUEMODEL AIR-OPERATED TIMED-OUT

*THIS AIR INDEX ADAPTOR CONVERTS THESE HEADS TO MOMENTARY ACTION

"every head meets every body at this gasket"

ALL SKYLINE HEADS AND BODIES ARE BUILDING BLOCKS TO GIVE YOU MANY VALVES FROM A FEW HEADS AND BODIES

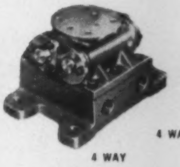

STRAIGHTWAY NORMALLY OPEN NORMALLY CLOSED

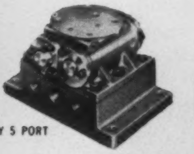
3 WAY NORMALLY OPEN NORMALLY CLOSED

"featured above"

4 WAY

3 WAY NORMALLY OPEN NORMALLY CLOSED


4 WAY


4 WAY 5 PORT

STAY AHEAD

MODERNIZE

ROSS OPERATING VALVE COMPANY
131 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

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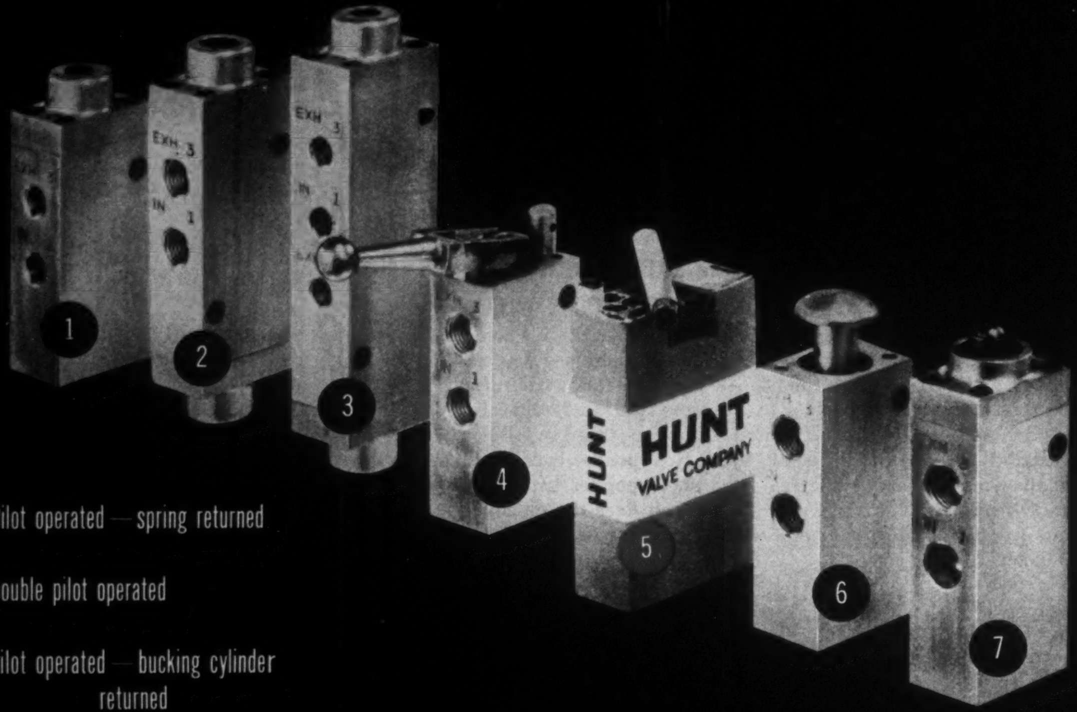
another
new valve
by **HUNT**

the TRIM LINE



1. Pilot operated — spring returned
2. Double pilot operated
3. Pilot operated — bucking cylinder returned
4. Lever operated
5. Reserved for valve actions to come
6. Palm-button operated
7. Ball actuated

An unbelievably small valve with a long, long life

Priced economically . . . that's TRIM LINE, Hunt's newest valve in a series of new valve designs.

The TRIM LINE is available in 3-way and 4-way actions. Furnished tapped for either ⅛″ or ¼″ pipe connections.

Designed for installations where space is limited, TRIM LINE is a quality valve you can depend on to work right . . . and to LAST. Just replace the "O" rings and it works on and on and on.

For complete details write to . . .

HUNT VALVE COMPANY • SALEM, OHIO, U.S.A.

HUNT ***Quick-As-Wink*** AIR & HYDRAULIC CONTROL VALVES

SEPTEMBER 1959
Vol. 6—No. 9

AUTOMATION®

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The Magazine of
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automation outlook

KEYSTONE FOR PROFIT

". . . probably the most significant step in the growth of an industry is the one in which primary emphasis changes from product engineering to manufacturing engineering. For as an industry matures, and competing product designs tend to stabilize, those companies who desire to remain in business must develop competitive methods of production. Manufacturing engineering thus becomes the keystone of the profitable manufacturing organization . . ." *—T. R. Bunnell, mgr., Manufacturing Services, Semiconductor Div., Sylvania Electric Products Inc., see page 48.*

GROWING COMPLEXITY

". . . there are already in existence weapons systems whose test and maintenance requirements exceed the capabilities of an automatic weapon system testing center which primarily controls events and measures voltage, frequency, and time . . . computer-controlled test centers have been undergoing considerable study. . ."*—G. B. Way, chief, Special Products Section; and Martin Rubin, supervisor, Automatic Checkout Unit, Computers and Controls Engineering; Autonetics, Div. North American Aviation Inc., see page 73.*

PRODUCTIVITY INCREASE NEEDED

". . . demands in the 1960's will require more and better products of greater reliability, produced in the most economical manner using a minimum effort . . . in the next ten years, to stay in business, a minimum increase of the mechanical output in relation to the manpower it requires must be between 50 and 100 per cent over-all. . . "*—H. Thomas Hallowell Jr., president, Standard Pressed Steel Co.*

HOW TO CUT COSTS

". . . there is . . . an alternative to a not-very-likely tax reduction. We can reduce costs. . . A 2 per cent cut in the cost of living . . . would achieve the same effect as a $6 billion cut in taxes. We in industry know that we can help to cut costs by using three very valuable and very powerful tools. They are modernization, automation, and research. . ." *—James H. Jewell, vice president, Westinghouse Electric Corp.*

DRIVE-IN EDP

". . . the day may not be far off when it will be as easy for a small businessman to visit a data processing center as it is for a housewife to visit a laundromat. Through the use of electronic data processing systems, the businessman—both large and small—will be able to handle paperwork more rapidly, more accurately, and more economically than ever before. . ."*—John L. Burns, president, Radio Corp. of America.*

STANDARDS AND INTERNATIONAL TRADE

". . . differing standards are, in their way, as effective trade barriers as are import quotas, tariffs, currency controls, and even embargoes. All such barriers, diverse standards included, work against the free flow of trade which is vital to the health and strength of our economy, and the economy of the rest of the free world. . ."*—Henry Kearns, Asst. Secy. of Commerce for International Affairs, U. S. Dept. of Commerce.*

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BPA NBP

...Fluid Power news

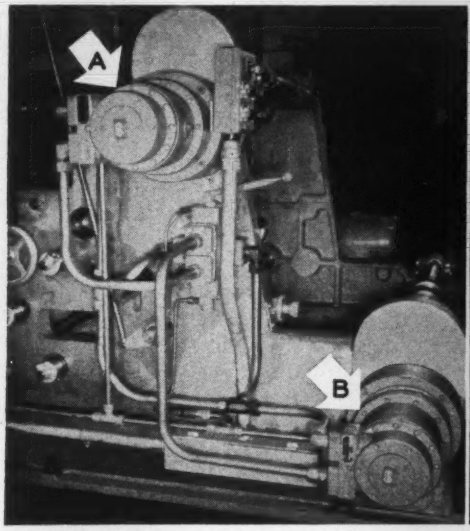
REPORT
No. 12,300
HIGH PERFORMANCE WINDER DRIVES

From Oilgear Application-Engineering Files

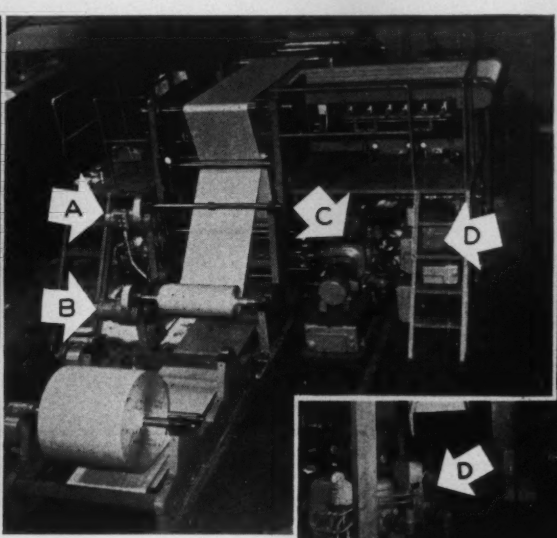
HOW OILGEAR PROGRESSIVE ENGINEERING PACES IMPROVEMENTS ON "BEMIS" MACHINES

CUSTOMER: *Bemis Bro. Bag Company, St. Louis, Missouri*

DATA: To efficiently produce the wide scope of paper, cloth, and polyethylene "Flexible Packaging" for which they are famous, "Bemis" designs and builds their own production machinery. Basically, "Bemis" machines are roll-fed, multi-color printing presses capable of very close register . . . operating from inching speeds of 15 fpm to running speeds of 400 to 1000 fpm. Press runs range from 1000 to 1,000,000 bags. Being roll-fed presses, winder drives and controls were a major problem, as ratios of 5:1 up to 10:1 from core to finished roll diameter are not uncommon. Paper widths vary from 10" to 56", with roll weights from 1000 to 2000 lb. "Bemis" specified that their winder drives must be compact; easy for shop, maintenance, and operator personnel to adjust, maintain, and understand. All electrical controls must be simple, with standard components preferred. Each machine to have one main control panel, and three or four remote, push-button panels — with some constant indication of load and tension as a desirable feature. Long, trouble and maintenance-free life was also of prime importance along with ease in installation.



Close-up of face-mounted, Oilgear Type "H" Fluid Power Motors (A, B), geared to rewind spindles of newest "Bemis" machine, shown center. Oilgear Type "D" Pump on "Power-Pak" (C) — center photo — supplies Fluid Power for rewind drive.



Newest "Bemis" press during "trial runs" prior to installation. Rewind motors (A, B) to left. Two Oilgear "Power-Paks" (C, D) with Oilgear Type "D" Pumps and Controls can be seen "tucked away" under the dryer section.

View "around-back" of new "Bemis" press dryer section, showing Oilgear Type "D" Pump and Controls on "Power-Pak" (D) which supplies Fluid Power to Oilgear Type "H" Motor (E) for main press drive. See "Note" below on Oilgear Pump (F), direct-coupled to tail-shaft of Motor (E).

SOLUTION: Through a program of constant improvement and engineering teamwork, Oilgear *Fluid Power* Drive and Control Systems have so successfully paced requirements for more efficient production equipment that "Bemis" plants in 16 cities now have 48 machines equipped with Oilgear winder drives. Dancer roll controls are used on 39 . . . 9 more recent installations have "*HYTAC SYSTEM" drives. Two newest machines (one shown above) have Oilgear Type "D" electrohydraulic servo controlled main press drives, and hydraulic servo controlled winder drives. One reason for this ever-increasing use of Oilgear "Any-Speed" drives has been clearly stated as follows: *"We put them in and forget about them . . . some have been operating for over 11 years without service or repair — many loaded to maximum capacity — others have had no oil change in five years"* . . . proof of the statement heard in all industry — *"For the lowest cost per year — it's Oilgear!"* One "Bemis" installation using a HYTAC SYSTEM winder drive handles 40 to 70-lb kraft stock 26" to 63" wide. This winder operates over a 13:1 ratio — from 3¼" diam. cores to 43½" diam. rolls — is limited only by interference on the machine. Of this HYTAC SYSTEM, "Bemis" states — *"Other types of variable speed drives could never do this . . . operating beyond our fondest hopes."*

*HYTAC SYSTEMS — An Oilgear Trademark

NOTE: *An unusual installation feature is partially visible on photo above. Oilgear Type "H" Fluid Power main press drive motor (E) is also direct-coupled to Oilgear Type "H" Pump (F) which supplies Fluid Power to an Oilgear Type "H" Motor — not shown — that drives the dryer fan.*

USER REPORTS — *" . . . exceptionally fine acceleration control . . . smooth creeping and inching speed up to maximum . . . exceptionally smooth running speed . . . are easier to adjust than other drives . . . require less space . . . pressure gage shows load while drive is in operation . . . maintain an adjustable tension from constant tension to constant torque."* "Bemis" — like other users — has found that Oilgear Drive and Control Systems give them constant tension, automatic tapering tension, stall tension, constant torque, automatic tapering torque, or a combination of tension and torque characteristics to meet their every production requirement.

For practical solutions to YOUR linear or rotary Controlled-Motion problem, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY
Application-Engineered Controlled Motion Systems
1598 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN

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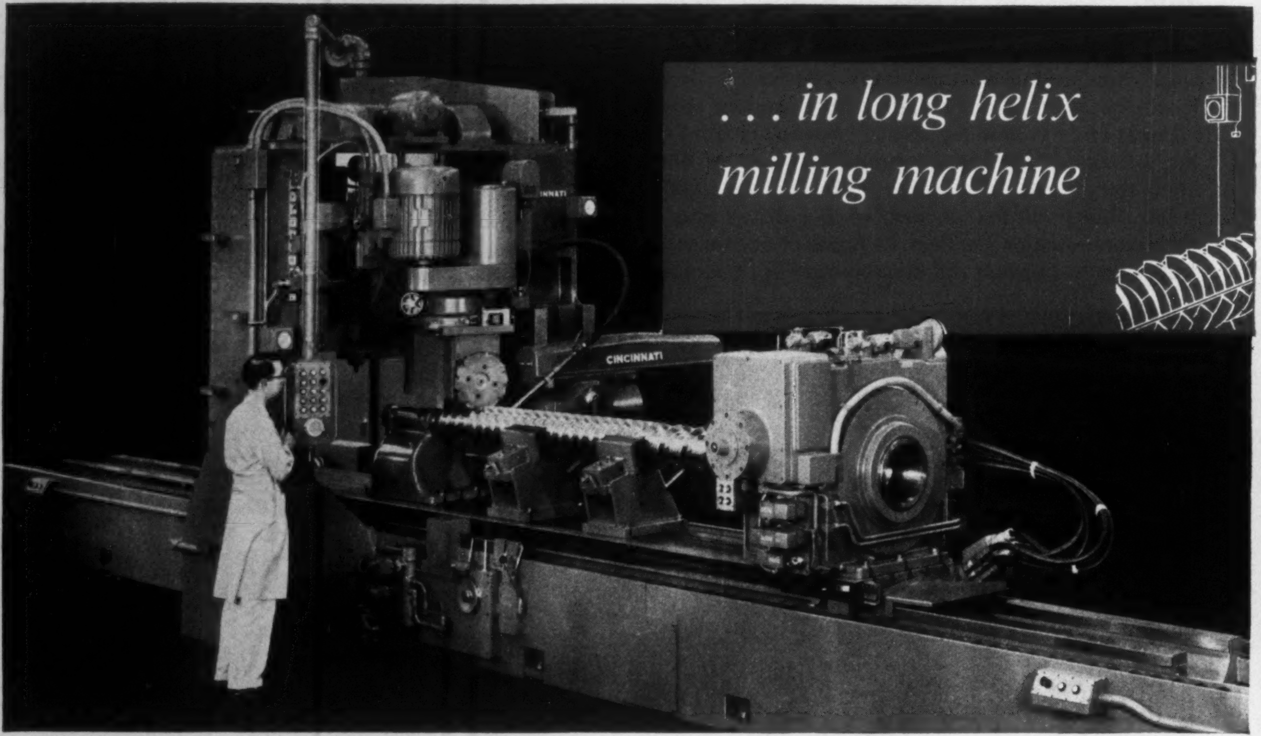
CINCINNATI | SPECIAL MACHINE DIVISION



. . . in long helix milling machine

Deep helix mixing screws, requiring four types of operations, are milled on this CINCINNATI Special Helix Milling Machine. It has the capacity to handle any size screw from 4" to 24" diameter, up to 24 feet long.
(Photo courtesy of Baker Perkins Inc., Saginaw, Mich.)

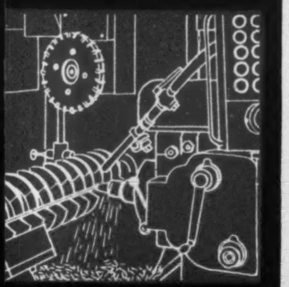
The helix on screws can perform many useful and diverse operations. It mixes chemicals, flour and other products in industries handling bulk materials. Milling the helix in a family of large screws for this type of equipment proved to be too expensive for one machinery builder, so he enlisted the aid of Cincinnati Milling's Special Machine Division. Their specialists developed a machine having a conventional horizontal spindle (standard HyPowermatic unit) and a heavy duty 20 hp universal spindle head. The helix is roughed out by the large cutter above the part, and finished with the end mill in the conventional horizontal spindle. Cincinnati's unique Telephase control system operates the fixture rotation in exact relation to table travel, producing an unusual combination of highly accurate right- and left-hand leads.

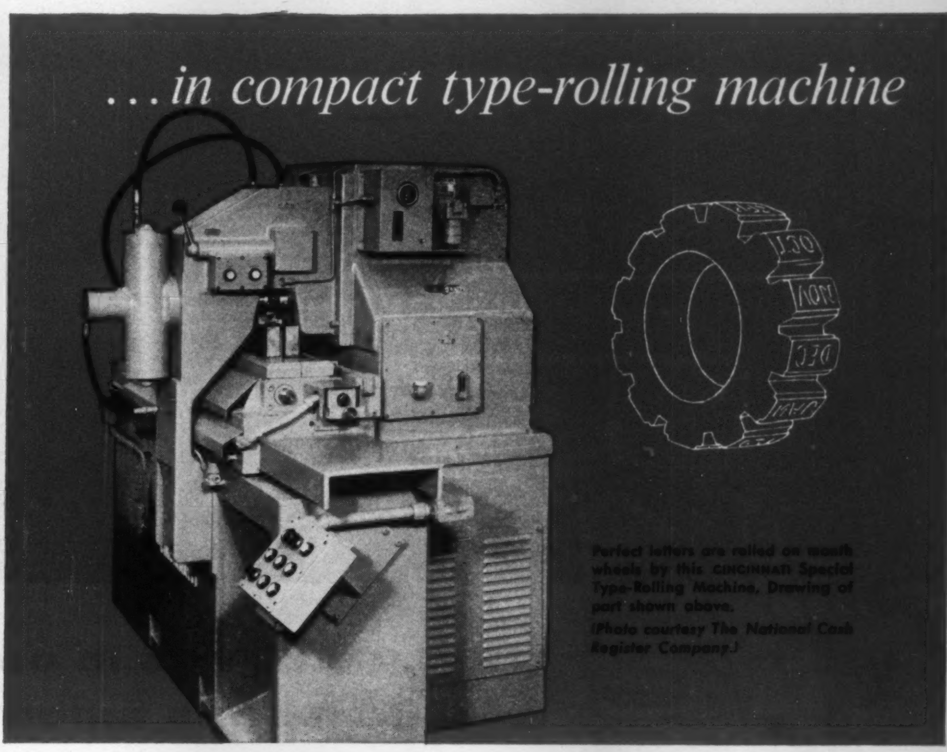
Many smaller units of production equipment, just as effective in reduc-

DESIGNERS AND BUILDERS OF SPECIAL MACHINES • VERTICAL AND HORIZONTAL BROACHING

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

incorporates Dependable Productivity





...in compact type-rolling machine

Perfect letters are rolled on month wheels by this CINCINNATI Special Type-Rolling Machine. Drawing of part shown above.

(Photo courtesy The National Cash Register Company.)

ing costs but lacking the glamour of big machines, also are designed and built by the Special Machine Division. The Automatic Type-Rolling Machine shown here is an example. It rolls month abbreviations, AUG., SEPT., etc., in the lands on month wheels. Pushing a button clamps the work; air jets keep the operation clean. Impressions are rolled 1/32" deep in 17 feed and 13 finishing passes, in a 55-second cycle.

Giant production lines; big machines having a high degree of "intelligence"; compact, single cycle machines... all are built by Cincinnati and are dependably operating in various plants, producing at the lowest possible cost. Our Field Engineers will be glad to show you what the Special Machine Division has done, and give you an analysis of what they can do for you.

CINCINNATI

MACHINES • COMPLETELY AUTOMATED PRODUCTION LINES

CINCINNATI

SPECIAL MACHINE DIVISION

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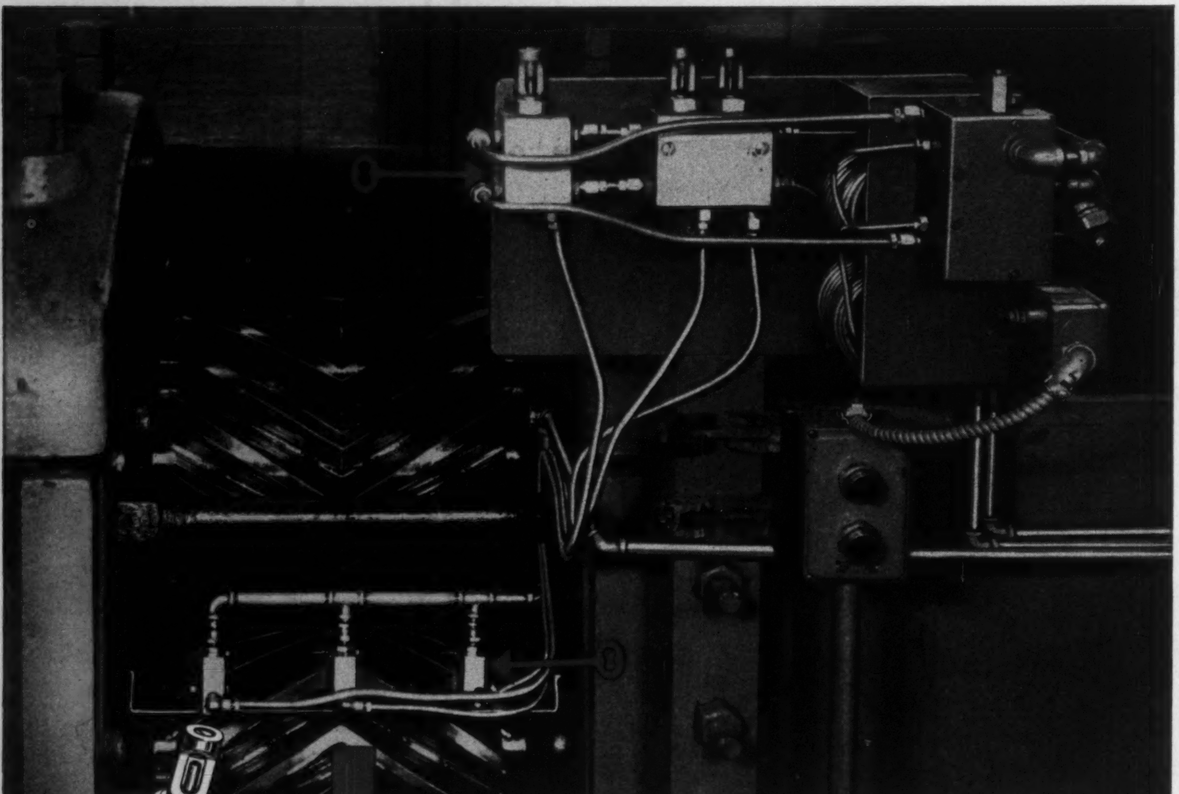

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Special Delivery
TO EVERY BEARING EVERYWHERE

FARVAL
—Studies in
Centralized
Lubrication
No. 234

$715.00 savings in one year paid for this automatic Farval Spray System

In this prominent brass manufacturing plant, herringbone gears for the hot commutator roll presented an acute lubrication problem. Manual lubrication procedures were inefficient, costly, and used excessive lubricant. Also, poor housekeeping — due to equipment being covered with wasted lubricant — was reflected in a high clean-up labor cost.

A modern Farval Spray Valve Lubrication System was installed and immediately solved the problems. Now the plant's operators report:

- Reduction of 84% in amount of lubricant formerly required
- Exactly measured amounts of lubricant are automatically delivered at six-minute intervals — eliminates the need for workmen to go near meshing gears
- Since installation of Farval, no maintenance has been required
- Housekeeping is no longer a problem — leakage and wasted lubricant have been entirely eliminated

Check with your Farval Representative and get the complete story on how these modern, automatic, centralized lubrication systems can improve your production operations — cut over-all costs, too. Or, write for free Bulletin 60-A.

The Farval Corporation, 3265 East 80th Street, Cleveland 4, Ohio.

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(Subsidiary of Eaton Manufacturing Company)

KEYS TO ADEQUATE LUBRICATION

—wherever you see the sign of Farval—familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.

FARVAL®
CENTRALIZED
SYSTEMS OF
LUBRICATION

Circle 657 on Page 19

AUTOMATION news

Today's events and developments in the field of automation

This Month In Chicago: The ISA Instrumentation Show

WHAT is your interest in instrumentation? Computers? Missiles and space? Pulp and paper? Chemical and petroleum? Data Handling? Feedback Control? Analysis? Photographic techniques? These are only a few of the many instrumentation fields that will be covered at the 14th Annual ISA Instrument-Automation Conference & Exhibit in Chicago on September 20-25, 1959.

During the 6-day conference, over 100 technical papers will be presented at the various sessions to be held at the Palmer House and Morrison Hotels. In addition, there are many clinics and workshops scheduled for down to earth discussions of your own instrumentation problems. Complementing the technical programs will be an exhibit of instrumentation equipment and computers at the International Amphitheatre sponsored by over 400 manufacturers and users.

Opportunities will be unlimited for cross-breeding of ideas between industries for virtually every instrumented industry in the country is represented in the numerous papers. Some of the diverse application topics to be discussed are missile launching, glass yarn manufacturing, food processing, wind tunnel testing, steel mill rolling, radar tracking, petroleum product analyzing, radiation monitoring, pulp and paper treating, and aircraft flight testing. Advances will be probed in such technological areas as control valve sizing, electronic counting, stress and strain inspecting, analog-digital converting, mass flow computing, variable speed regulating, vibration analyzing, photographic instrument measuring, electric valve positioning, low-level multiplexing, magnetic tape recording, dimensional gaging, and process optimizing.

Special sessions will be tailored to the interests of executive management, maintenance management, sales management, educators, standards personnel, and technicians. All in all, the Instrument Society of America is sponsoring a terrific program. They have done the hard work of bringing together the experts for you to see, hear, and talk to. It's to your advantage to make the most of it.

FIER Reports On Its Second Year Of Operation

TO ENCOURAGE the more rapid development and the wider use of instrumentation technology, the Foundation for Instrumentation Education and Research (FIER) was established in 1957. Basic operating funds for FIER are derived from a surcharge on space purchased by exhibitors at annual Instrument Society of America Instrument-Automation Exhibits. Other financial

14th Annual ISA Instrument-Automation Conference & Exhibit

September 20-25, 1959 **Chicago, Illinois**

Technical Sessions, Workshops, and Clinics — Palmer House and Morrison Hotels

Exhibits — International Amphitheatre

Here's a convenient Check List of Technical Sessions, Workshops, and Clinics.

SUNDAY ....SEPT. 20, 1959

- ☐ **Instrumentation Clinic**
  Steel & Ceramics, Chemical & Petroleum, Power Plants, Food, General
- ☐ **Sales Management Workshop**

MONDAY ....SEPT. 21, 1959

- ☐ **Keynote Session**
- ☐ **National Lecture Series**
- ☐ **Control Systems Workshop**
- ☐ **Instrumentation Clinic**
  Steel & Ceramics, Chemical & Petroleum, Power Plants, Food, General

TUESDAY ....SEPT. 22, 1959

- ☐ **International Session**
- ☐ **Automotive Instrumentation**
- ☐ **Pulp & Paper Controls**
- ☐ **Data Handling Workshop**
- ☐ **Maintenance Management WS**
- ☐ **Precision Standards WS**

WEDNESDAY ....SEPT. 23, 1959

- ☐ **Aeronautical Instruments**
- ☐ **Missile/Space Instruments**
- ☐ **Chemical & Petroleum Controls**
- ☐ **Management & Economics**
- ☐ **Nuclear Instrumentation**
- ☐ **Mechanical Measurements**
- ☐ **Data Handling & Computation**
- ☐ **Continuous Analysis**
- ☐ **Computers In Process Control**
- ☐ **Food Instrument Workshop**
- ☐ **Annual Banquet**

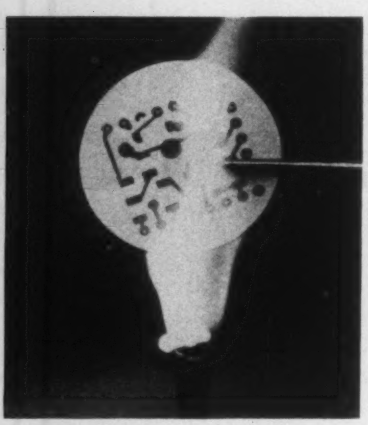
THURSDAY ....SEPT. 24, 1959

- ☐ **Measurement & Control**
- ☐ **Analysis Instrumentation**
- ☐ **Medical Analysis Instruments**
- ☐ **Electronic Instrumentation**
- ☐ **Feedback Control Systems**
- ☐ **Photographic Instrumentation**
- ☐ **Standards & Practices**
- ☐ **Educator's Workshop**
- ☐ **Computer Clinic**

support is provided by grants from the National Science Foundation.

During its second operating year, FIER accomplished many worthy projects. The dissemination of information relating to education, research, and new developments in the field of instrumentation technology was carried out through published articles, meetings with groups of educators, and talks before industrial organizations and technical societies.

To attract a larger number of outstanding students into graduate study in the instrumentation field, and to encourage more institutions of higher learning to develop graduate courses in instrumentation technology, FIER launched a program of graduate fellowships. These fellowships are supported by contributions from manufacturers and users of instrumentation. For the academic year 1959-1960, six fellowships are to be provided by Daystrom Inc., Foxboro Co., Leeds & Northrup Co., Minneapolis - Honeywell Regulator Co., Panellit Corp., and a group of California petroleum refiners and contractors including Bechtel Corp., C. F. Braun & Co., Richfield Oil Corp., and Union Oil Co. of Calif.



MOLYMANGANESE printed circuit developed by Advanced Vacuum Products Inc. can operate without deterioration in temperatures exceeding 1300F. The substrate or base material on which the wiring is printed is made of alumina. A molybdenum-manganese compound is used for the wiring and is fired onto the alumina and subsequently brazed. Bonding is so adherent that the circuit cannot be removed from the alumina base without destroying the ceramic. The circuits are still in the development stage, and the problems of making large units have not been completely solved.

To bring groups of scientists and engineers working in specialized areas of technology up to date on the newest instrumentation techniques, FIER initiated and conducted several cross-fertilization clinics. These brought meteorologists, tool engineers, and others together with instrumentation experts. The success of these clinics calls for an expansion of this activity in the future.

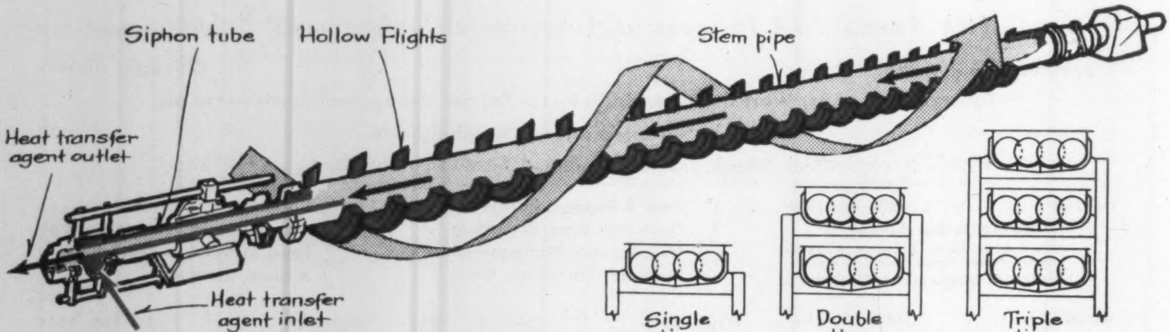
Surveys and studies conducted by FIER have revealed that the first step toward better education in instrumentation must be teacher training. Through initiating special summer courses for teachers, FIER is tackling this problem at several levels.

In all these activities, FIER has engaged the interest and active participation of technical societies, educational institutions, and government agencies in co-operative effort. FIER's role has been one of initiating, organizing, and supervising these joint ventures.

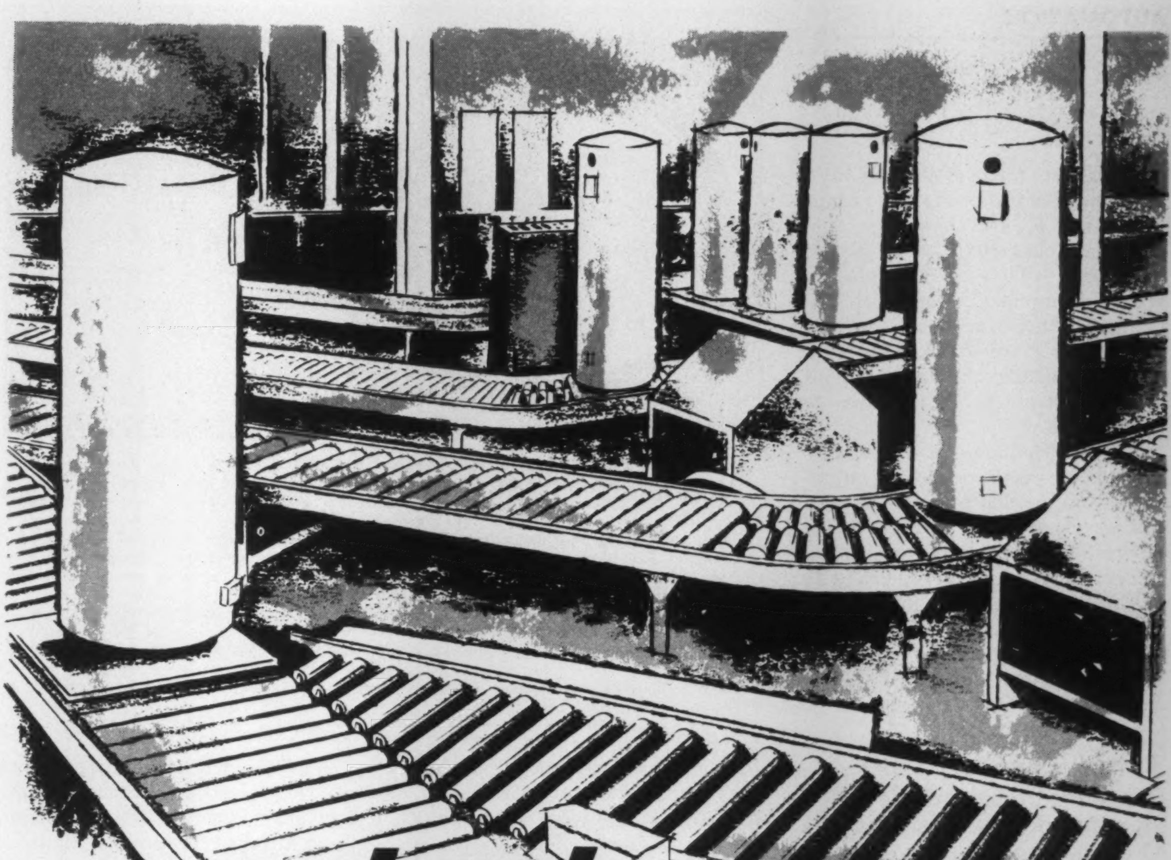
Glass Encapsulating Material Melts As Low As 257F

GLASS compositions with low melting characteristics have been developed by **Drs. S. S. Flaschen** and **A. D. Pearson** of Bell Telephone Laboratories. Composed of varying proportions of sulfur or selenium and the heavy metals arsenic and thallium, the glasses become very fluid at temperatures between 125 and 350C (257 and 662F). This temperature range is approximately 300 to 400C (572 to 752F) lower than the range for any previously known low-melting glass.

In the fluid state, the glass compositions have viscosities equal to that of castor oil at room temperature. This viscosity is suitable for encapsulating semiconducting devices, capacitors, resistors, and printed circuit boards by a simple dipping procedure.



SCREW-TYPE heat exchanger developed by Western Precipitation Corp. combines maximum heat exchange area with minimum space requirements. Heat transfer agents such as refrigerants, cold or hot water, hot oil, or steam are circulated through the helical, hollow flights of the screw from left to right and then are returned to the outlet through the hollow stem pipe. At the same time, material being processed is moved through a trough from left to right by the screw. System can be used for cooling, heating, or drying and calcining. The screws are nested and intermeshed in troughs in twins or quads according to the tonnage, space limitations, and time of retention required by the process. Four diameters of screws are available ranging from 7 to 24 inches and made of various metals—steel, stainless steel, monel, aluminum, copper, bronze, and other alloys. In most cases, the heat exchanger operates at a predetermined screw speed between 1 and 20 rpm. According to the requirements of a particular installation, the heat exchanger may consist of one or more units arranged in vertical tiers, as side-by-side units, or in a single line. Over-all length of each unit ranges from 15 to 33 feet, depending upon screw diameter. Troughs can be furnished with open tops or with covers for atmospheric, pressure, or vacuum operations.



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tough handling problems

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BETTER ON ALVEY - ENGINEERED CONVEYOR SYSTEMS

Imaginative Alvey engineering has increased production, smashed bottlenecks, saved time and manpower, accelerated production schedules in many industries . . . in many plants, including those where it was assumed it "couldn't be done."

Alvey first analyzes every step of your operation . . . approaches the project as **entirely new** . . . then applies the engineering talent and experience that has scored money-saving successes over some of the toughest problems ever posed in materials and parts handling. It costs you nothing to get the facts . . . write or call now!

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Esso Standard Oil Co.
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General Tire and Rubber
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Knox Glass Co.
DuPont
Hot Point
Scott Paper
Goodrich-Gulf Chemicals, Inc.

ALVEY

CONVEYOR MANUFACTURING COMPANY
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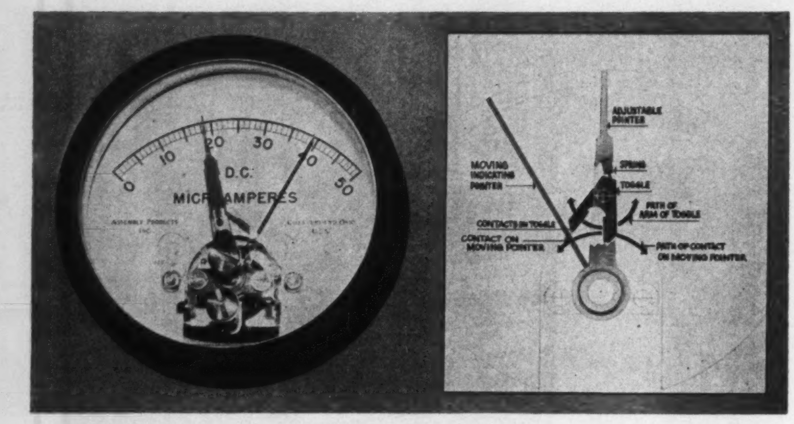
ROLLER, BELT, APRON, PUSHER BAR, SPIRAL, AND SLAT CONVEYORS • PACKAGE HANDLING SPECIALTIES

Circle 658 on Page 19

The glasses range electrically from semiconductors to insulators. Chemically, the glasses show the same durability characteristics as glasses in general. They are insoluble in water, dilute alkalis, acids including hydrofluoric acid, and organic solvents, but are attacked by concentrated alkalis. Several compositions are stable to air oxidation to above 250C.

The low-melting glasses are also unusual in that they can be evaporated and condensed as thin glass films. Coating of semiconducting devices with the compositions is under study. In experiments with silicon diodes, excellent initial characteristics have been attained. In addition, improvements have been observed when such units were heated or operated.



CONTINUOUS reading meter-relay developed by Assembly Products Inc. incorporates a new design which allows the indicating pointer to continue to show signal level after passing the set point at which control circuits are energized. Key to the new design is an inverted V-shaped toggle having contacts on each arm. As the pointer reaches the set point and contacts the toggle, a circuit is closed through both a booster coil and a multipole load relay coil. The booster coil assures firm contact action. Contacts on the load relay initiate the desired control action and also cause a surge of current to pass through the meter-relay movement. This adds sufficient torque to the pointer to cause it to snap the toggle and move past it, de-energizing the booster coil. The load relay remains energized as long as the signal is higher than the set point, and the pointer is free to fluctuate with signal variations. When the signal drops below the set point, the pointer again contacts the toggle, energizing the booster coil and de-energizing the load relay. After the pointer snaps the toggle back to its original position, the booster coil is again de-energized.

Remote Supervisory System Transmits Verbal Trouble Calls

SUPERVISION of a remote, unattended operating area by a central control center usually requires that a pair of wires be continuously connected between the two areas at all times. If the public telephone system is used for this connection, a private line must be rented to provide continuous service. In order to eliminate the necessity of renting a private telephone line, an English concern, Sound Diffusion (Auto-Thermatic) Ltd., has developed a novel system of supervisory control which operates over public telephone lines.

The Datafonic system is unique in two ways: One, it only transmits information by telephone when a change in operating conditions occurs at the remote station, and two, it actually dials the central control station and gives a verbal description of the change. The battery-operated system uses a prerecorded disc which contains up to 40 units of verbal information, each unit describing a possible condition of the supervised equipment such as current off, oil level low, bearings overheating, line pressure dropped, etc. When a malfunction occurs and the central control is contacted, the record plays all 40 pieces of information in sequence, but only statements concerning the actual condition of the piece of equipment are transmitted. Selection of information transmitted is electrical, not mechanical, and each statement takes approximately 3 seconds permitting the entire record to be transmitted in about 2 minutes.

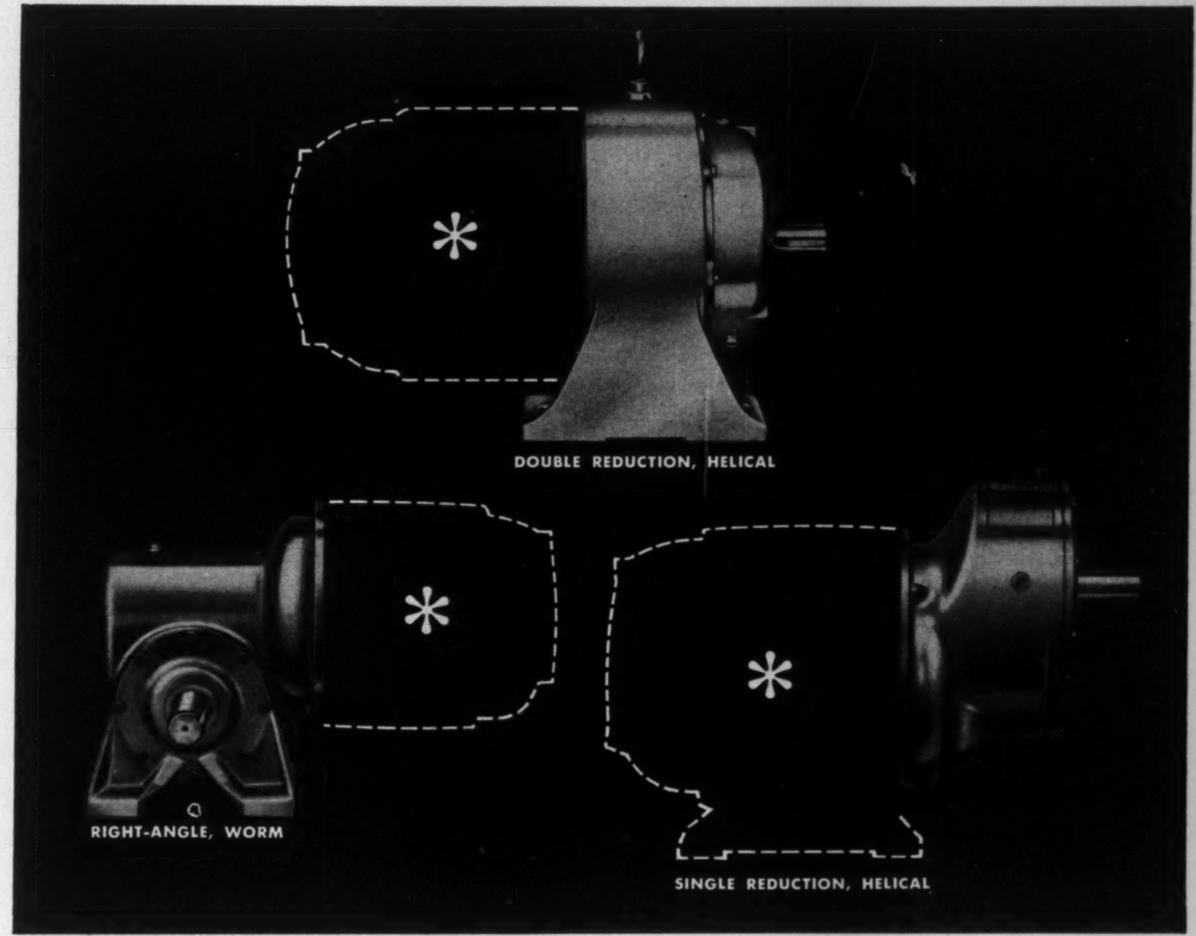
Operation of system in unattended electrical substation would be as follows: Each substation breaker would have two prerecorded messages, one stating the breaker was closed and the other stating the breaker was open. When a breaker trips open, an auxiliary pair of contacts on the breaker actuates the Datafonic system, causing relays to close the telephone line and dial the central control station. At the end of the dialing sequence, a verbal statement is transmitted twice, identifying the substation. Then the position of each breaker is described, including the one that is tripped. A typical message would be: "This is Welton 4585. This is Welton 4585. This is an automatic emergency call from Welton Park Substation (repeated once). Stand by for breaker positions. Breaker 1 closed. Breaker 2 closed, Breaker 3 open, Breaker 4 closed . . . Send acknowledgement signal now."

The acknowledgement signal consists of a 3 second duration audio tone generated by a transistor oscillator attached to the telephone at the central control. The operator on duty actuates this signal when he understands the message. If the remote station receives no acknowledgement, it would repeat the telephone call three more times at 3 minute intervals before abandoning its efforts to reach the control room. A second message sequence also can be recorded on the disc so that an alternate number can be called if the first number does not acknowledge the call.

Hydraulic Feed Control Offsets Variations In Temperature

IMPROVED hydraulic control system has been developed by Burg Tool Mfg. Co. for its line of automatic turret drilling machines. The new system compensates for temperature variations that normally affect hydraulic feed rates.

A new temperature-compensated oil flow control will maintain constant feed rates under normal operating conditions. Feed rates can be dial calibrated, and a setting can always be made reliably. In doing so, the actual feed rate will cor-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DOUBLE REDUCTION, HELICAL
*
RIGHT-ANGLE, WORM
*
SINGLE REDUCTION, HELICAL

Need a Motoreducer with an unusual drive motor?

LET REULAND TAILOR A MOTOREDUCER
PACKAGE TO YOUR EXACT NEEDS . . .

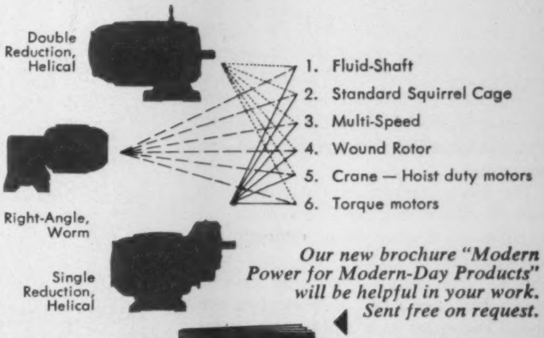
No longer must you "make something do" . . . no longer must you modify *your* machine to fit the *drive!* Hundreds of different speed and power variations can be developed from the three basic Reuland gear reduction units shown above.

This is made possible through the use of Reuland's famous "Xpandable-Design" idea.

Whether you need a simple motor-and-reducer – or an amazing, automatic combination with a special motor, gear reducer, magnetic brake and fluid coupling – Reuland engineers can quickly solve your drive problem.

Costs are lowered. Development time is saved. Your drive is *right*. Why not see first-hand what a Reuland Motoreducer can do for you.

* ***ADD ANY ONE OF THESE 6 DRIVE MOTORS TO ANY OF THE 3 GEAR REDUCTION UNITS SHOWN ABOVE . . .***


Double Reduction, Helical
Right-Angle, Worm
Single Reduction, Helical
1. Fluid-Shaft
2. Standard Squirrel Cage
3. Multi-Speed
4. Wound Rotor
5. Crane — Hoist duty motors
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Circle 659 on Page 19

respond with the feed rate setting within normal temperature ranges. No hydraulic warm up time is required, feed selection is simplified, and the chances of reaching an erratic feed setting are greatly minimized.

New Burgmaster automatic hydraulic turret drilling machines will come equipped with the improved temperature-compensating hydraulic system. Machines installed prior to this innovation can also be equipped with the new control. For older machines, the company is offering a do-it-yourself changeover kit which contains complete instructions and assemblies.

Electronic Machine Reads Typewritten Material

DEVELOPMENT of new information machine which reads typewritten pages and translates them into electrical signals at the rate of 200 characters per second has been announced by the United States Air Force Air Research and Development Command. The machine was developed by the Intelligent Machines Research Div., Farrington Mfg. Co.

Automatic "reading" of printed information is based in part on techniques used in 25 Farrington print reading machines installed at various commercial companies. However, the Air Force machine is more advanced than any commercial machine in that it reads ordinary typewritten sheets having both upper-case and lower-case alphabetical characters, numerals which are self-checking for accuracy, and punctuation symbols. So far, the machine can only read one type style, but research is continuing to overcome this limitation.

The print reader scans one typewritten line at a time, character by character. Each character scanned produces a TV-like video impulse which is analyzed by logic circuits for various identification clues. Upon identification, the reader translates the intelligence into an electrical signal for further machine processing. Output of the machine can be punched paper tape, punched cards, or magnetic tape, or the signals can be fed directly into an electronic computer.

At the present time fifteen commercial reading machines are being used by eight oil companies in their credit card billing systems. These models, called Scandex, read the account numbers on customer invoices and convert the invoices into punched cards for further processing. Other Farrington reading machines are being used at the First National City Bank, New York, for processing travelers' checks; at National Biscuit Co., New York, as a printed list reader; at Readers Digest, Pleasantville, N. Y., for book club record processing; at American Telephone and Telegraph Co., New York, for dividend check processing; and at Ohio Bell Telephone Co., Cleveland, for cash accounting. An experimental model of a letter reader is being tested by the United States Post Office Dept. for reading printed addresses in a mail sorting system.

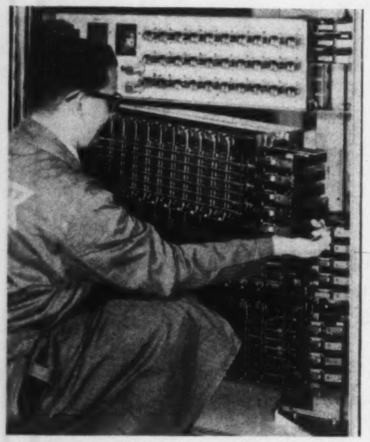
A New Welding Technique: Electron-Beam Welding

IN CO-OPERATION with its inventors at the Atomic Energy Commission in France, Sciaky Bros. Inc. is developing electron-beam welding equipment for use in this country. This new fastening process practically eliminates weld contamination in highly reactive metals such

Crossbar Switches Provide Machine Memory System

MANY control systems for numerically controlled machines require a memory system to retain information during the time interval between tape reading and machine action. An ideal memory system combines simplicity, compactness, and dependability with ease of maintenance. The engineers of Fosdick Machine Tool Co. did not think that existing memory systems contained these attributes and searched for a better means of storing information.

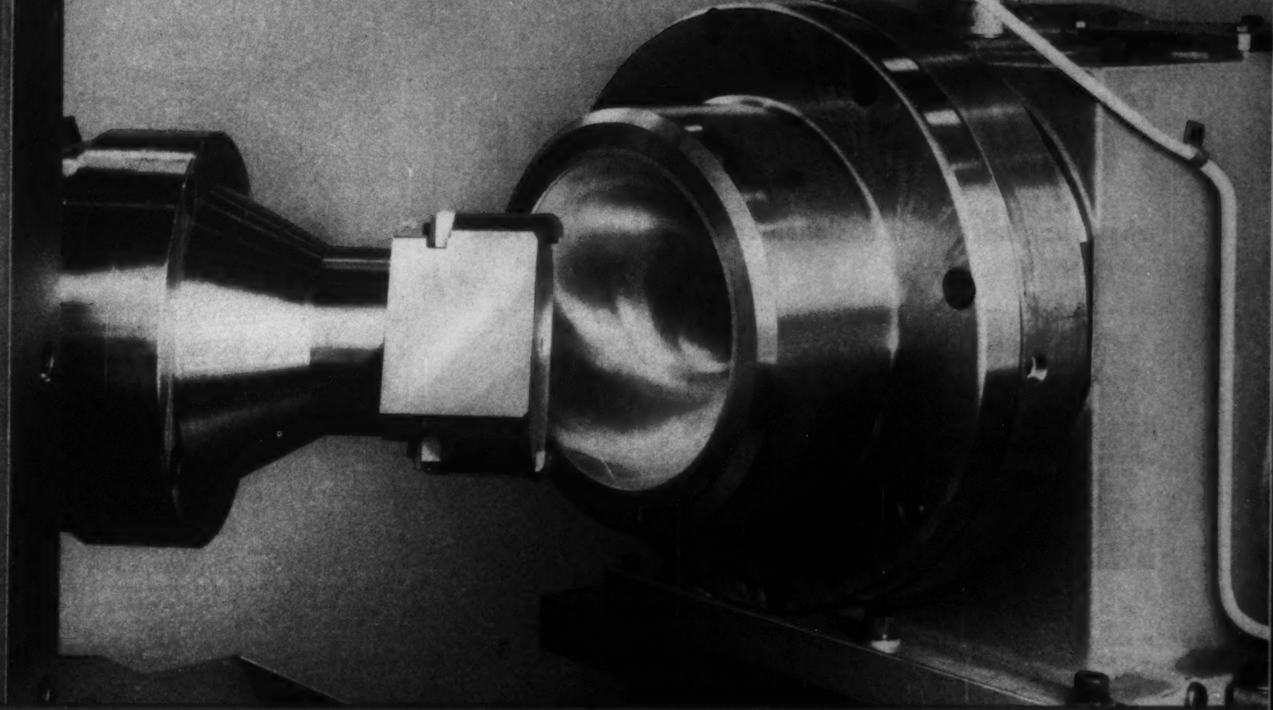
The electromechanical memory system that Fosdick's engineers developed exemplifies the importance to automation of crossbreeding time-tested ideas and techniques. For many years the crossbar switch has been a key component in telephone exchanges as a multicontact superselector switch. However, its potentialities as an industrial control system component had not been widely recognized. Through mutual exchange of information between industries, the engineers at Fosdick recognized that the crossbar switch would make an ideal component for a memory system.



As its name implies, the crossbar switch is a grating of crossed bars which are actuated by electromagnets. Each switch contains 10 vertical columns of 10 contacts which provide 100 "pockets" for holding information. By feeding information into the switch through the horizontal bars and using the vertical bars to pick it up, hold it, and release it on demand, a very efficient electro-mechanical memory system is possible.

Fosdick applied the crossbar switch as a memory unit for its numerically controlled boring machines. Since each crossbar switch can store ten lines of digital information, it required only two switches to store all the data needed to control spindle feeds and speeds, and two axes of table movement. A third switch can handle spindle depth control and tool designations. If automatic tool changing is required, a fourth switch could be installed in the standard control and tape reader console furnished with the machines.

This use of the crossbar switch for information storage is a new application in the machine tool industry for a component that is slowly being obsoleted by electronics in the communication field. Without crossbreeding of ideas between industries, its potentialities in the industrial control field might never have been recognized.



EX-CELL-O CUSTOM TURNING MACHINE
MEETS DEMAND WITH PERFORMANCE

WORK: Rough and finish turning of I.D. and O.D. with automatic cycling between loads.

ACCURACY: Less than .0001″ tolerance on radii and .0001″ on total wall thickness. Surface finish to 10 rms.

MATERIAL: Wrought or forged annealed aluminum hemispheres, 6″ to 16″ dia.

XLO
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Custom-equipped with gages, spindle tachometers and other features, hemisphere-turning machine is a job-tailored "special"—yet it is designed to accommodate future production changeover.

59-34

Here are just a few of the reasons why this special Ex-Cell-O Turning Machine meets demand with *precision performance*—every time:

An extremely accurate and rigid work spindle helps slim-down the hemispheres shown at a rate of 15 cu. in. per minute with a ⅛″ cut. Separate variable-speed hydraulic motors give cutter speeds from 50 rpm to 2500 rpm, and work spindle speeds from 1/18 rpm to 4 rpm. Dial gages provide constant checks on work spindle slide and cutter plunge depth. Vacuum chucks hold the work securely, and full electrical interlocking protects operator and machine during production.

Perhaps a similar Ex-Cell-O special machine—designed to handle future work as well—is the answer to a production problem in your operation. Call your Ex-Cell-O Representative, or write direct for full details.

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Circle 660 on Page 19

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when your machine is designed around a Standard Tool

INDEXING UNIT

The Heart of Automatic Machines

MODEL ST-A9A

Compact light to medium duty cam indexing unit, 8 to 20 index positions, 90° to 270° cams, 13½" to 24" dial plates. Accuracy ± .001 at 8" radius.

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Heavy duty cam indexing unit, 8 to 24 index positions, 18" to 24" dial plates. Accuracy ± .001 at 10½" radius. Production rate 600 to 6000 per hour.

MODEL ST-A18

Conveyor or transfer type, straight line indexing chassis, 27 to 51 work carriers, production rate 1000 to 6000 per hour, station distances 3" to 6". Accuracy ± .003

Technical Booklets Sent on Request!

Standard Tool engineers will be pleased to help you in selecting the indexing unit to meet your exact requirements.

Also ask for Standard Tool facilities brochure.

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STANDARD TOOL AUTOMATION

Since 1910

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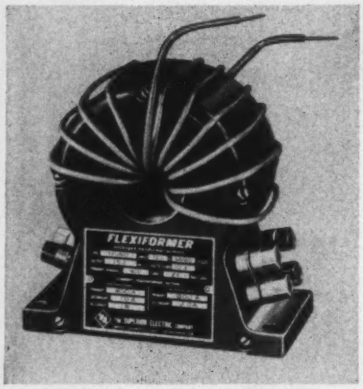

PACKAGED primary transformer coil available from Superior Electric Co. eliminates the necessity of stocking many fixed-ratio transformers. When a desired output voltage is required, it can be obtained by hand winding the proper number of secondary turns around the primary coil. The primary coil has 400 turns of 24 gage copper wire, and has an input rating of 120 volts, 50/60 cycles, single phase current. The primary coil can also be used as a current transformer by passing a wire through the center opening. Coil then becomes a secondary winding which can be used to measure currents up to 400 amperes with an accuracy of 1 per cent at 60 cycles.

---

as uranium, zirconium, beryllium, tungsten, molybdenum, and tantalum.

Electron-beam welding joins the edges of workpieces by fusion or melting. This is accomplished by the bombardment of the parts with a focused beam of electrons produced by an electron gun. As this concentrated beam contacts the workpiece surface, the electrons' kinetic energy is changed to heat which causes melting. The weld area can be controlled by varying electron velocity, or the number of electrons being emitted from the electron gun filament. Electrons are accelerated as voltage increases.

The most significant aspect of the new process is that it is performed in vacuum rather than in a protective atmosphere. It is primarily this feature which practically eliminates weld contamination. The stainless steel vacuum chamber developed for the process has an inside diameter of 24 inches and an inside length of 30 inches. The vacuum pumping equipment includes a 10-inch diffusion pump, a 120-cfm mechanical backup pump, and a 3½-cfm mechanical holding pump.

Three electron gun assemblies are available to cover a full range of

around the triangle

METAL FINISHING BY VIBRATION

Controlled vibration has become a stock in trade for the manufacturing engineer, but here is a new way of putting it to good use. Roto-Finish Co. has developed a new machine for cleaning, descaling, deburring, radiusing, fine finishing, and coloring of metal parts that uses a vibrating motor attached to the bottom of a tank. Vibration is induced throughout the abrasive mass by a system of eccentric weights integrally mounted with the motor. Time cycles are very short with a production rate up to 1000 per cent greater than for parts processed by conventional barrel tumbling techniques.

NEW PROCESS PROMISES CHEAPER TITANIUM

Although titanium is the fourth most plentiful structural metal found on earth, only 4500 tons were produced in 1958 due to the difficulties in extracting it from its ore. Current price of titanium is about $9 a pound in the form of bar and sheet stock. Norton Co. has hopes of dropping this price by means of a recently developed electrolytic process that extracts titanium from titanium carbide. Although still in the laboratory stage, the new process has produced 12-pound batches of titanium metal having a purity of about 99.6 per cent. The company believes that continuous production at an economical cost is possible using full-scale equipment.

ESTABLISHES LOAD RATINGS FOR BALL AND ROLLER BEARINGS

For the first time, an American Standard method of evaluating load ratings for ball and roller bearings has been established. Published by the American Standards Association, the new American Standard B3.11-1959 establishes uniform test procedures and statistical methods for determining load-carrying capacity and expected fatigue life for both ball and roller bearings. It covers dynamic as well as static capacity of radial and thrust type bearings and contains definitions of bearing life, basic load rating, equivalent load, basic static rating, and static equivalent load. Copies are available at $1.75 each from the American Standards Association.

MORE BITS TO THE INCH

Heretofore, the maximum operating speeds of computers have been limited by the input and output devices which are primarily magnetic tape handling facilities. Potter Instrument Co. has recently announced a high density magnetic tape recording system which has the capability of recording and reproducing digital information at a pulse density of 1500 per inch with no discernible error. Using the new system, transfer of data to or from a computer can be accomplished at rates in excess of 500,000 numbers per second. Since more information can be recorded on each tape reel, magnetic tape files can be reduced by a factor of approximately 7 to 1.

NECESSITY—THE MOTHER OF INVENTION

In 1935 a faculty member of the California Institute of Technology was approached by a former classmate who needed a practical device for determining the acidity of lemon juice. Tackling the problem, the faculty member soon developed a meter for determining pH. This led to other inquiries, and, before long, the faculty member was manufacturing pH meters in a roped-off section of a garage. Today, the garage has grown into a $50 million a year business and has become Beckman Instruments Inc. with the former faculty member, Dr. Arnold O. Beckman, as its president. In recognition of his achievements and continuing contributions to science, industry, and education, the Instrument Society of America will present Dr. Beckman with its highest award, lifetime honorary membership in the society, at its annual banquet during the 14th Annual Instrument-Automation Conference and Exhibit.

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welding. The guns operate from a high-voltage power supply capable of delivering from 0 to 15,000 volts and up to 500 milliamperes of current. The equipment is designed to operate from 440-volt, 3-phase, 60-cycle power supply lines.

An operator can position the internal electron gun by means of controls outside the chamber. The gun can be moved in a horizontal plane from one side of the chamber to the other so that it may cover a part having a weld width of 12 inches. A rotating chuck is also provided for circumferential welding of 5-inch diameter cylinders. Longitudinal welding can be accomplished by replacing the chuck with a rack and gear arrangement to obtain a linear movement. All welding operations are clearly visible through viewing windows in the chamber.

Compressed Air Operates Free-Piston Pump

FREE-PISTON pump developed by Crossley Machine Co. has only 9 moving parts and will pump molten metals, ice cream, slurries, concrete, syrups, sludge, plastics, acids, and semisolids. Operated by compressed

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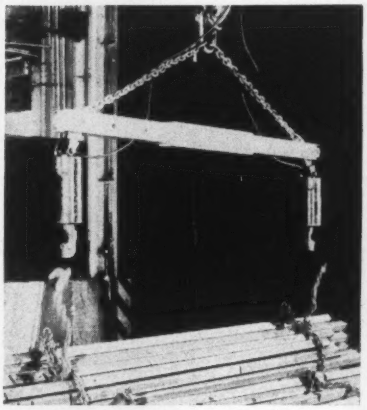
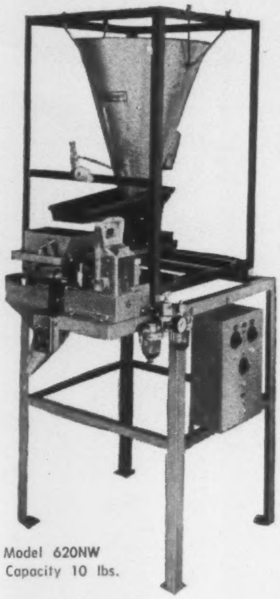


SOLENOID chain release developed by American Chain Div., American Chain & Cable Co. Inc., permits the safe release of heavy loads under conditions where it is dangerous for an operator to manually unload a hook. The unit is remotely controlled by a crane operator who presses a button to activate the solenoids at each end of a spreader bar. The solenoids expel the chains from the hooks to release the load. All loads must be on the floor with tension removed from the chains before the solenoids can be operated. The device is available in either single or double spreader bar models.

EXACT WEIGHT® Automatic Net Weighing Machine



Model 620NW
Capacity 10 lbs.

FOR PACKAGING, BAGGING, BATCHING, COMPOUNDING

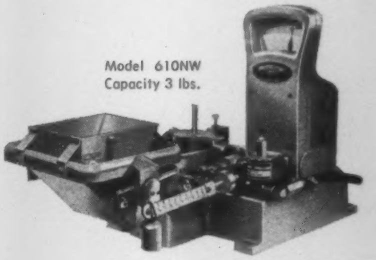
Exact Weight offers:

- Precision industrial-type scale.
- Over-under indicator visual check eliminating need for separate checkweighing operation.
- Calibrated adjustments with counterweights of known value; graduated beam, poise and scale indicator.
- Design backed by 45 years of experience in specialized weighing equipment.
- Readily accessible service and maintenance facilities.
- Performance guaranteed in writing.

Weighs and feeds any dry, free-flowing materials . . . fast and accurate operation . . . helps cut production costs. Write for Bulletin 3318 for details and specifications.

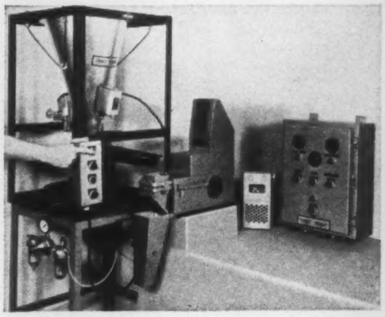
Automatic Net Weigher

Net Weigher can be supplied without the feeder machine, support frame and discharge chute. The unit may be adaptable to your specific operation. Write for Bulletin 3311.



Model 610NW
Capacity 3 lbs.

Precision Automatic Net Weighing Machine



Model 4601NW, left, for weighing dry products with accuracies of 1/10 gram on quantities below 10 grams and one percent accuracy on quantities of 10 grams and above. Combines a high - accuracy Shadograph Scale, air-operated dump mechanism, hoppers, vibratory feeders and photoelectric controls. Models with capacities from 50 grams to 500 grams. Write for Bulletin 3363.

THE EXACT WEIGHT SCALE CO.
907 W. FIFTH AVE., COLUMBUS 8, OHIO
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Exact Weight SCALES

Sales and Service Coast to Coast

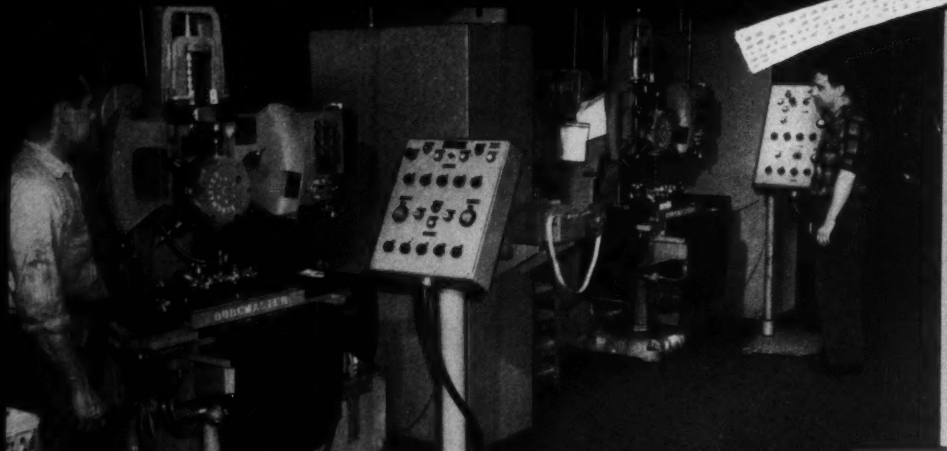
Find us in your local 'Yellow Pages'

BETTER QUALITY CONTROL . . . BETTER COST CONTROL

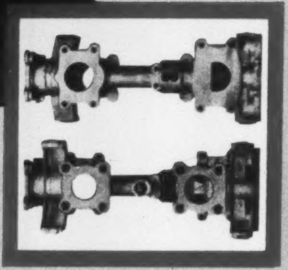
Circle 662 on Page 19

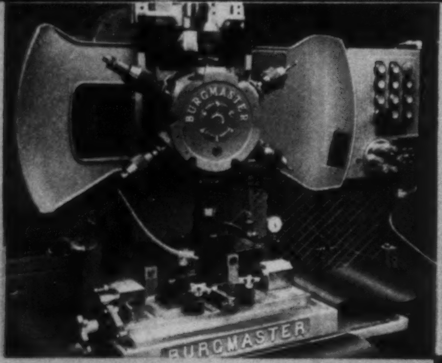
Stainless Steel Valve Body

BURGMASTER *tape controlled*

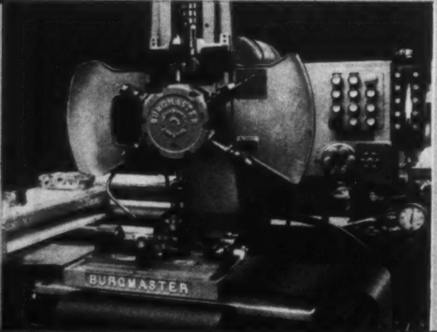


#347 Stainless Steel Valve Bodies now machined on Automatic Tape Controlled Burgmasters to far better than the required ±.002" tolerances. Former time was 2.7 hours. Present time is ½ hour.





1st operation showing the simple quick clamping fixture, and tooling required to perform 32 precision drilling and c'boring operations.



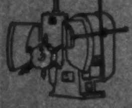
2nd operation showing simple Fixture and tooling used to perform 27 drilling and reaming operations.

World's Largest Builder of Turret Drilling Machines

"O" Manual
Power Index
¼" Capacity

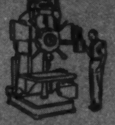
1C Manual
Power Index
¾" Capacity

2B Manual
Power Index
¾" Capacity



2BF Flange Mounted
Power Index
¾" Capacity

2BH Automatic
Hydraulic
¾" Capacity



3BH Automatic
Hydraulic
1½" Capacity

2BR Ram Type
Radial Drill
¾" Capacity

2BHT-3BHT Auto
Tape Controll
¾" and 1½" Ca

Production Increased 440% with...

6 SPINDLE TURRET DRILL

(at Standard-Thomson Corp., Waltham, Mass.)

Two Burgmaster G. E. Tape Controlled 6 Spindle Turret Drilling Machines used for machining #347 Stainless Steel Valve Bodies at Standard-Thomson Corporation, Clifford Mfg. Co. Division, Waltham, Mass. have increased production 440% as compared to a multiple drilling set-up using dowel location holding fixtures. The valve jobs are now machined in 2 set-ups (one per machine) and a total of 59 operations including drilling, c'boring and reaming are automatically performed in ½ hour rather than the former time of 2.7 hours.

The machines were purchased expressly for this job although they will also be used for other work. "The repetition of controls has been perfect, and dimensions are held far beyond the required tolerance."

MAXIMUM FLEXIBLE AUTOMATION is obtained from Burgmaster 6 and 8 spindle Turret Drilling, Tapping and Boring machines because they can be quickly and economically set up to produce a large variety of parts using standard tools and simple work holding clamps.

The standard adjustable Burgmaster controls are maintained...including pre-selective spindle speeds, infinitely variable pre-selective feeds, slective rapid approach and return, skip indexing, precision depth control, and simple manual controls for set-up. The G. E. numerical system controls all machine functions, selects spindles in any sequence, automatically positions the table on two axes, clamps the table while machining operations are performed, and controls coolant. Up to 6 or 8 different operations can be performed at any command position without moving the table, or as many cycles using one tool as desired, without indexing. All operations are carried out at their most efficient rate for high finish, precision, speed, and longest tool life. As a result one man can operate two or more machines on many jobs, or by attaching two tapes together one part can be machined on one end of the table while work is being set up on the other to effect constant machine operation.

Whether your work is small lots or high production you can obtain exceptional savings and production increases with Burgmaster Tape Controlled Turret Drills. Our representatives will be glad to discuss this possibility on your work with you, at no obligation. Just call.

JOB FACTS

Machines: Two Burgmaster Tape Controlled Turret Drills.
Parts: Valve Bodies #347 Stainless Steel
Lot Size: 50
Holding Fixtures: Simple quick acting clamps
Operations: 59 — C'Drilling, Drilling, C'Boring and Reaming
Accuracy: ±.002" required
Former Time: 1st operation — 1.2 hours
2nd operation — 1.5 hours
Total: 2.7 hours
Present Time: 1st operation — .17 hours
2nd operation — .33 hours
Total: .5 hours
Savings: 2.2 hours
Production Increase: 440%
Other Advantages: Far better accuracy than required; repetition of controls has been perfect.

Write for Bulletin describing Burgmaster 6 and 8 Spindle Tape Controlled Turret Drilling, Tapping, and Boring Machines. Thirty-minute 16mm sound film showing all Burgmaster Turret Drills in operation is available from any office without charge.

BURGMASTER
TAPE CONTROLLED

BURG TOOL
MANUFACTURING COMPANY, INC.
15001 South Figueroa Street, Gardena, California
FAculty 1-3510 DAvis 9-4158

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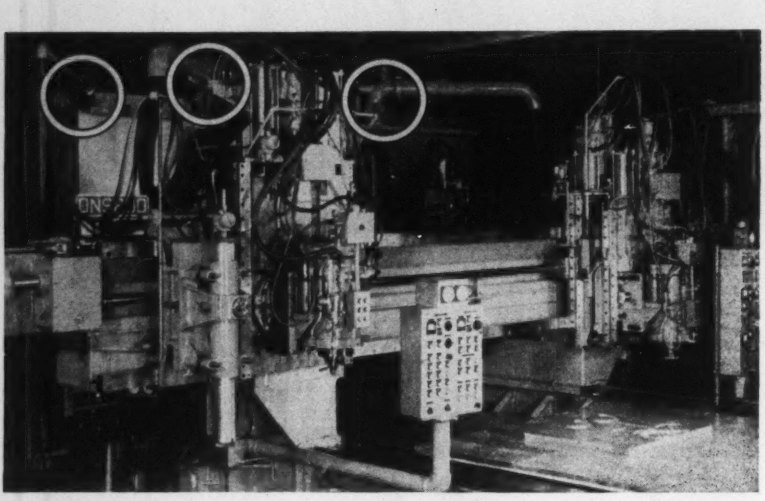
Circle 663 on Page 19

air, the pump impels a continuous material flow without pulsating or surging. It requires no packings, seals, oils, greases, safety valves, or directly connected drive units, and can be operated with complete safety and efficiency submerged.

The pump has three stainless steel cylinders, each containing a nylon free floating piston and two nylon valves. Compressed air is introduced into each cylinder in sequence so that while the one chamber is discharging, the second cylinder has filled and is waiting, and a third chamber is filling. Operation is automatically controlled by a separate control box. Since one cylinder can be stopped while the other two continue to function, the pump can operate indefinitely without being shutdown. Any size of pump can be made to order.



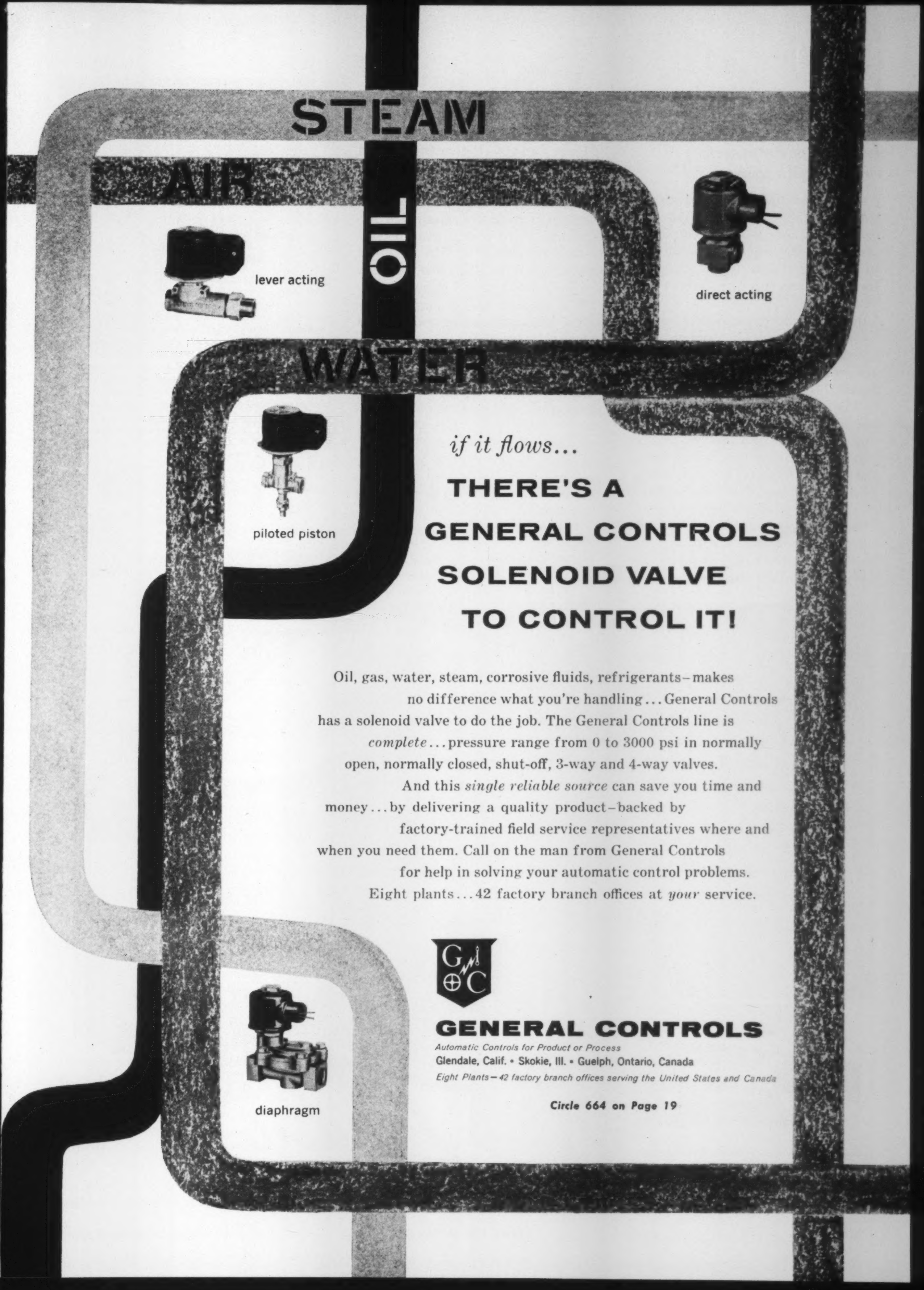
SWIVEL pipe joints, normally used for liquid service, solved a knotty design problem on this large contour milling machine. The machine is capable of milling aerodynamic shapes from aluminum stock as large as 9 by 45 feet. Three high-speed spindles, mounted on a traveling cross-rail, do the actual cutting, and each head is supplied by a number of electrical cables and coolant tubes. The design problem was to keep the cables lifted free of the work area, but flexible enough to move with the cross-rail and with the spindles as they traversed the rail and tilted toward the work. The solution was to house the cables in heavy conduit and to use swivel pipe joints at the pivot points. Standard swivel joints with dual ball-bearing races were furnished by Chiksan Co., subsidiary of Food Machinery & Chemical Corp. and provided sufficient strength and mobility to handle the weight of the cantilevered conduit.

SPOTLIGHTING PEOPLE

Robert W. Kerr elected president of Fairbanks, Morse & Co. . . . **John O. Peterson** appointed vice president of Thayer Scale Corp. and vice president and general manager of Thayer Mfg. Corp. . . . **Herbert A. France Jr.** named manager of quality control for Pratt & Whitney Co. Inc. . . . **Lester A. Bateman** appointed executive vice president of Hunt Valve Co. . . . **Wilford H. Ross** appointed research supervisor of the Chemical Processing Div., and **Robert J. Jones** named research supervisor of New Process Development at Detrex Chemical Industries Inc. . . . **Harold Weiss** appointed manager of applications engineering, Computer Dept., General Electric Co. . . . **David C. McNeely** named manager of Helipot Div., Beckman Instruments Inc. . . . **Peter H. Fratangelo** appointed chief engineer of Mackintosh-Hemphill Div., E. W. Bliss Co. . . . **Andrew C. Bayle** elected vice president-engineering of the Waltham Precision Instrument Co. . . . **Kenneth Goodman** appointed chief engineer of Engineered Electronics Co. . . . **David L. Dumond** named chief engineer of the Machine Tool Div., Clearing Division of U. S. Industries Inc. . . . **Robert E. Lehman** appointed manufacturing manager of Pulse Engineering Inc. . . . **Linwood C. Huff** named manager of commercial engineering at Clevite Transistor Products . . . **George Beckwell** appointed research and development engineer at Pines Engineering Co. Inc. . . . **Raymond R. Bourret** named manager of manufacturing of Precision Instrument Co. . . . **Robert W. Matthews** appointed chief engineer of National Pneumatic Co. Inc. and its Holtzer-Cabot Divisions . . . **Olaf Landeck** joined Electro Engineering Works as production manager . . . **Charles R. Martin** named supervisory engineer responsible for development activities in the Control Dept., Allis-Chalmers Mfg. Co. . . . **Peter C. Jurs** elected president of Shand and Jurs Co. . . . **William Kneen** appointed chief project engineer, Analytical & Control Instrument Div., Consolidated Electrodynamics Corp. . . . **A. Vetter** named manager of Overseas Operations for the Cross Co. . . . **William E. Seaman** appointed chief engineer of Midwestern Instruments Inc. . . . **Dr. L. G. Massey** appointed head of the Computer Dept., Universal Oil Products Co. . . . **William F. Newbold** named director of research for the Brown Instrument Div., Minneapolis-Honeywell Regulator Co. . . . **James N. F. Reynolds Jr.** appointed vice president-manufacturing for Van Norman Industries Inc. . . . **Frederick A. Fielder** elected vice president and general manager of the Loewy-Hydropress Div., Baldwin-Lima-Hamilton Corp.

SPOTLIGHTING PLANTS

Ex-Cell-O Corp. is moving the machinery building operations of its subsidiary, E. G. Staude Mfg. Co. Inc., from St. Paul, Minn., to an Ex-Cell-O plant in Bluffton, Ohio. The subsidiary manufactures a line of paper box making machines, as well as related machines for printing, gluing, wrapping, slotting, and similar packaging functions. . . . **Marshall Industries** is the name of a new corporation formed by the merger of Wahlgren Electrical Mfg. Co., Electro Physics Laboratories Inc., and the Instruments Div., Components Div., and the Distributor Div. of G. S. Marshall Co. . . . **Cross Co.**, builder of automation machinery and equipment, has acquired the firm of Stephen F. Malaker Associates, consultants in the nuclear and electronics fields. The new acquisition has been named the Cross-Malaker Laboratories Inc. and will be operated as a wholly owned subsidiary. . . .



if it flows...

THERE'S A GENERAL CONTROLS SOLENOID VALVE TO CONTROL IT!

Oil, gas, water, steam, corrosive fluids, refrigerants–makes no difference what you're handling . . . General Controls has a solenoid valve to do the job. The General Controls line is *complete* . . . pressure range from 0 to 3000 psi in normally open, normally closed, shut-off, 3-way and 4-way valves. And this *single reliable source* can save you time and money . . . by delivering a quality product–backed by factory-trained field service representatives where and when you need them. Call on the man from General Controls for help in solving your automatic control problems. Eight plants . . . 42 factory branch offices at *your* service.

GENERAL CONTROLS

Automatic Controls for Product or Process
Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada
Eight Plants—42 factory branch offices serving the United States and Canada

Circle 664 on Page 19

Louden Automation in Handling

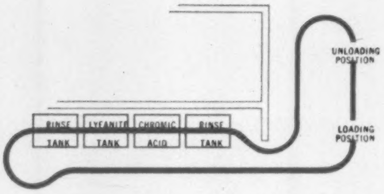
here pays for itself every eight months

As labor saving, cost saving and time saving become more and more important, automation and unattended operation gain equally in importance. Now, your materials handling can be automatic and completely unattended with a Louden Selectomatic-Automatic Dispatch System . . . further indication of Louden's ability to turn the many advantages of overhead handling to your greatest benefit.

The installation shown here is in the Johnson Motors, Waukegan, Illinois, outboard motor plant. Its function is to carry aluminum parts through a Lyfaniting (anti-corrosion) process. The moment its basket is loaded by one man and the button pushed, the Louden unit carries on by itself, dipping the basket contents into four tanks, one after another, for stipulated periods of time, and then delivering its load to a second man who unloads it. The Selectomatic-Automatic Dispatch System replaces a hand-operated monorail system and accomplishes in *one* shift what it used to take 3 shifts to do. On an initial investment of only $16,000, this user is saving in excess of $25,000 a year.

The Louden Selectomatic-Automatic Dispatch is the guaranteed product of the pioneers and oldest company in the field of specialized monorail handling. When you have a materials handling problem or any plant problem involving lifting and transporting loads, call on a Louden engineering representative for suggestions. This will cost you nothing, but may well prove to be the most profitable action you have ever taken.

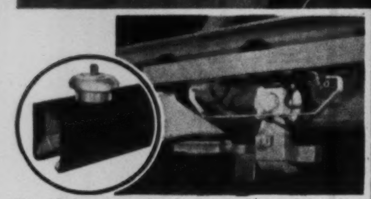
THE LOUDEN MACHINERY COMPANY
9609 Broadway, Fairfield, Iowa
A Subsidiary of Mechanical Handling Systems Inc.



Louden Selectomatic-Automatic Dispatch

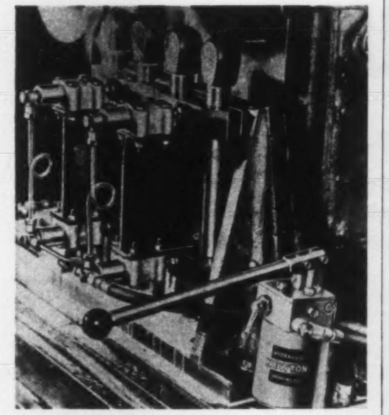
Louden Selectomatic-Automatic Dispatch not only offers the means for fully automatic materials handling, but frequently provides the key link in the automation of manufacturing or processing operations. Some of its successful applications have been relatively simple, others have been extremely complex in which many carriers travel unattended over hundreds of feet of track and are coordinated with numerous functions and other mechanical equipment. To understand the many opportunities offered by Louden Selectomatic-Automatic Dispatch, write today for your copy of the new Louden book, "Automatic Materials Handling." A folder on the new Louden Shok-Pruf Electrification for cranes and monorail will be enclosed.

Louden
SHOK-PRUF
Electrification
Automatic
Materials
Handling



New! Louden Shok-Pruf Electrification for all monorail and crane installations. Hazards of open conductor bars now completely overcome by this exclusive Louden engineering development. Write for full details of this safe conductor system.

Louden
MONORAIL & CRANES
SINCE 1867..THE FIRST NAME IN MATERIALS HANDLING



HYDRAULIC clamping system developed by Newton Hydraulic Tooling Co. actuates as many as 120 clamps from a single, self-contained hydraulic source. Operation shown uses four clamps to hold parts on a wet grinding machine. The system is manufactured in various sizes and types of components which can be combined to handle most clamping operations. Since the complete hydraulic system can be mounted directly on a fixture and requires no external connections, the fixture can be rotated in the machine for different work positions or moved to and from the machine between operations.

Florida Production Engineering Co. is the name of a new concern in Daytona Beach, Fla., which will specialize in the design and building of tools, dies, and automated machinery. . . . **General Electric Co.** is transferring the engineering, manufacturing, and marketing functions for its resistance welding control line from the Specialty Control Dept., Waynesboro, Va., to the Service Shops Dept. in Detroit, Mich. . . . **United Electrodynamics Inc.** has acquired the Electronics Div. of Rheem Mfg. Co. which manufactures power amplifiers, signal conditioning equipment, airborne power supplies, and transistorized amplifiers. The acquisition does not include any of Rheem's physical plant or real property, but does include product inventories, work in progress, patents, design drawings, and manufacturing equipment. . . . **Friden Inc.** has acquired Cummington Corp. by a stock exchange and has purchased the assets of International Postal Supply Co. Both of the acquired companies manufacture postal and mailroom equipment and will complement Friden's present line of such equipment. . . . **TelAutograph Corp.** has entered into an agree-

MORE CYCLES PER DOLLAR WITH NEW "PEERLESS" FIBRE CONTROL TAPE

than with any other tape material!

Strong tape prevents perforation "stretch," wears *ten times* longer than paper, costs *one-sixth* that of polyester film!

Are your tape costs running too high, or tape-wearing properties too low? Check the new "Peerless" control tape made of National Vulcanized Fibre, the only tape of its kind.

Most significant is "Peerless" cycle life:

Speed	*Paper Tape*	*"Peerless" Tape*
1200 rpm	76 to 120 cycles	2,000 and over
620 rpm	1200 to 1900 cycles	28,000 and still running

This special cellulose plastic tape combines toughness, high tensile and bending strength with flexibility. It has high density, excellent abrasion resistance and is easily punched. Thicknesses: .0043 and .005". Colors: Red, Gray, Blue.

In addition, "Peerless" will not stretch in use . . . your precision-punched holes remain true, and there is no distortion of photo-cell activation. "Peerless" tape is plastic-smooth and impurity-free; friction and wear on punching and feeding equipment are cut to the minimum.

"Peerless" tape is available in any width. It is already proving its superior wear and cost on major automatic programming equipment in industry, Government and business. Write today for a free test sample and complete information. Dept. ZZ-9.

NATIONAL VULCANIZED FIBRE CO., Wilmington 99, Del.

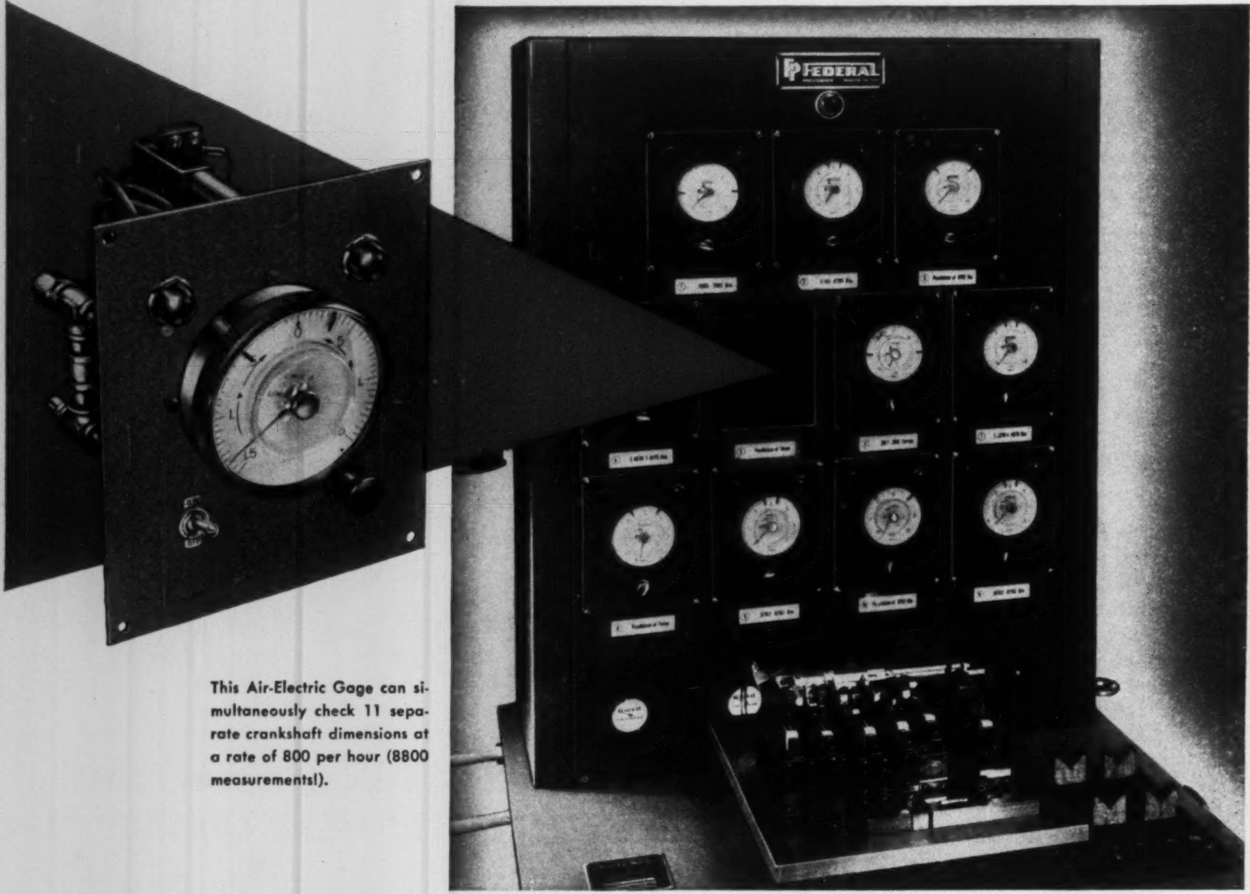
In Canada: NATIONAL FIBRE CO. OF CANADA, LTD., Toronto 3, Ont.

Circle 666 on Page 19

2 FEDERAL FEATURES FOR

● MODULAR DESIGN . . .

Meter switch units are standardized for lower cost and self-contained for quick interchangeability. *Result* — lower gage price, gage downtime virtually eliminated.



This Air-Electric Gage can simultaneously check 11 separate crankshaft dimensions at a rate of 800 per hour (8800 measurements!).

There isn't a production line gage in use that doesn't need care and service. Good design keeps this to a practical minimum. However, few, if any, designs have been aimed deliberately at reducing the amount of time needed to effect service or replacement . . . a critical consideration in production costs. But Federal's MODULAR design arranges construction so that gage downtime is reduced to moments. Only four screws, two finger-tight air hose connections and an electrical connector are involved in replacement of one meter unit by another. Then the replaced unit can be serviced at the bench when convenient. And, with Federal's one-master air system, setting the replacement unit takes only *10 seconds.* Even though the overall gage design is special to suit the particular requirements, these MODULAR units are standardized, which means lower first cost.

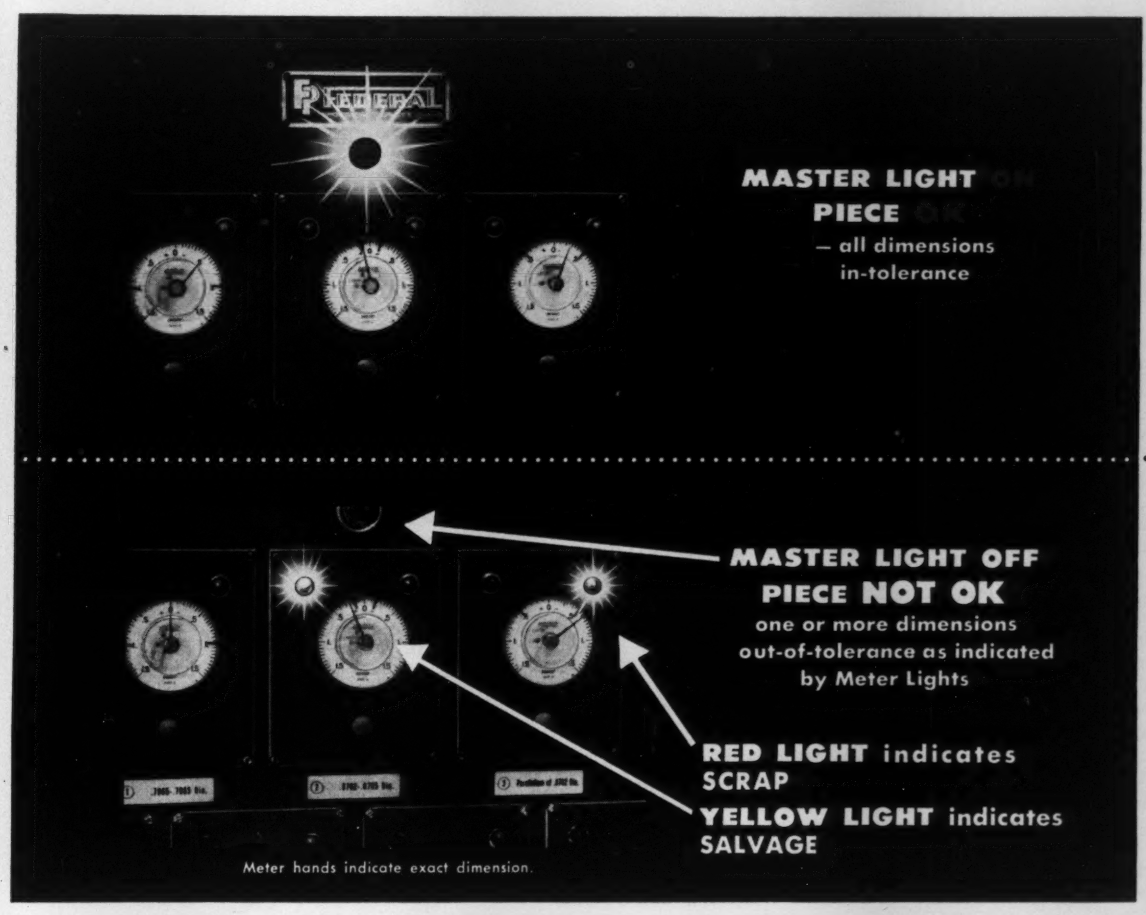
Get in touch with your Federal representative and investigate MODULAR design further . . . in terms of your own needs.

FEDERAL PRODUCTS CORPORATION
9399 Eddy Street, Providence 1, R. I.

MORE EFFECTIVE GAGING

● MASTER LIGHT CONCEPT...

Lets gage's accuracy, rather than operator's judgment, determine piece acceptability. *Result* — gaging speed doubled, errors eliminated.



MASTER LIGHT
PIECE
— all dimensions
in-tolerance

MASTER LIGHT OFF
PIECE NOT OK
one or more dimensions
out-of-tolerance as indicated
by Meter Lights

RED LIGHT indicates
SCRAP

YELLOW LIGHT indicates
SALVAGE

Meter hands indicate exact dimension.

Ordinarily, a multiple dimension gage requires the operator to determine—from scanning a row of bobbins or meters—the dimensional conformance of the piece being gaged. To keep up with the production pace, this must be done quickly . . . often leading to errors, especially in borderline decisions. Also, the fatigue factor in this type of gaging is high, accounting for additional inspection errors.

But Federal's MASTER LIGHT concept eliminates these errors by making acceptability decisions for the operator . . . without hesitation . . . without prejudice . . . without fatigue . . . *without error.* It does more than that, actually. If one or more of the dimensions are "out", the gage spots these and tells the operator instantly whether the piece must be scrapped or whether it can be reworked. Small wonder that this method can increase gaging speed over 100% . . . an increase that can easily mean needing only one gage-operator combination, instead of two, in order to keep pace with production needs.

Another advance that means more economy when you do business with Federal. Talk it over with your Federal representative soon.

Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

PLANNING TO MODERNIZE
FOR INCREASED
PRODUCTION
AT
LOWER COST?

CHECK

THE IMPORTANT ADVANTAGES OF
STANDARD CONVEYOR'S
EQUIPMENT AND SERVICE

A Standard system of conveyors is *engineered* to your individual production process or physical layout of your plant. Standard conveyors are designed and built to handle volume without halt, congestion or breakdown.

For more than 50 years Standard Conveyor has concentrated on the design, manufacture and application of power and gravity conveyors and related equipment for the handling of varied commodities. This specialization has developed improved design and construction in the conveyor equipment . . . and has given us an invaluable reservoir to draw upon in meeting your material handling problems.

Check with your experienced Standard engineer before you begin your modernization planning. His recommendation will save on initial costs as well as assure continued economies in handling costs for the future.

For Production • Assembly • Packing Lines • Roller and Belt Conveyors

To keep things moving — on production, assembly, processing or packing lines—mechanize your handling with conveyors. Standard furnishes all types — power and gravity, belt, roller, slat, chain, push-bar, sectional.

TO CUT COSTS WITH CONVEYORS—ASK STANDARD

STANDARD CONVEYOR COMPANY
General Offices: North St. Paul 9, Minn.
Sales and Service in Principal Cities

Standard
OVER 50 years of conveyor experience
GRAVITY & POWER
CONVEYORS

Call the Standard engineer listed in your classified phone book, or write direct for Bulletin 309—address Dept. EE-9.

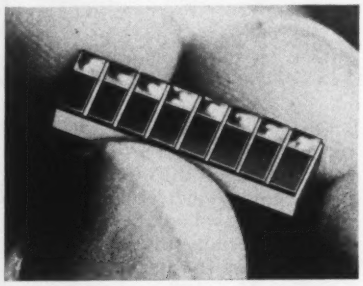
ment to purchase Hogan Laboratories Inc. and its wholly-owned subsidiary, Faxsimile Inc. In the transaction, TelAutograph acquires the Hogan manufacturing facilities, assets, and patents, but Hogan retains ownership of existing patent licenses.

MEETINGS AND EVENTS

Sept. 13-17—
Pressed Metal Institute. Annual meeting to be held at the Stanley Hotel, Estes Park, Colo. Additional information is available from Harold A. Daschner, PMI headquarters, 3673 Lee Rd., Cleveland 20, Ohio.

Sept. 15-17—
Ohio State University. Short course on Advanced Principles of Flow Measurement sponsored by the Flow Measurement Research Group, Mechanical Engineering Dept. Meeting will be held at Ohio State University, Columbus, Ohio. Additional information is available from Charles F. Sepsy, Mechanical Engineering Dept., Ohio State University, 206 W. 18th Ave., Columbus 10, Ohio.

Sept. 17-18—
American Society of Mechanical Engineers. Engineering management conference to be held at the Statler-Hilton Hotel, Los Angeles,

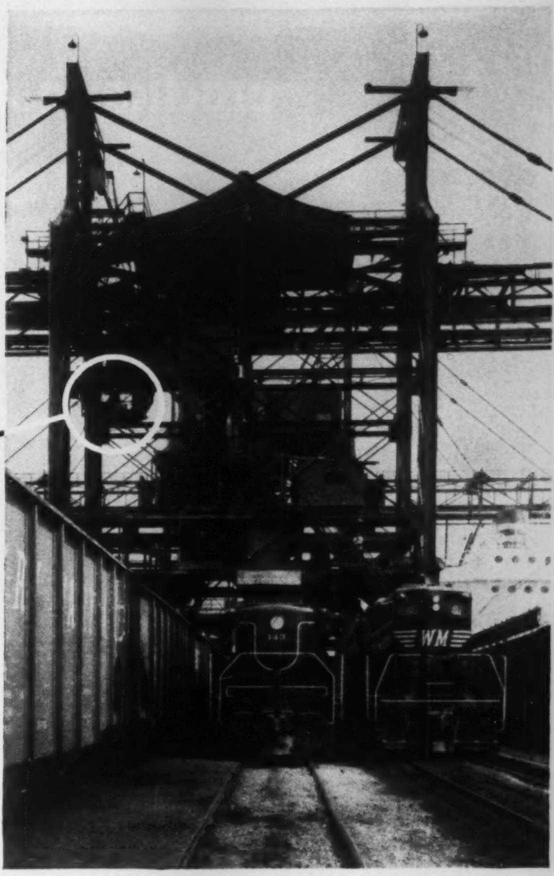


SILICON photovoltaic readout matrices for reading punched cards or punched tape in data processing systems are available from International Rectifier Corp. Each matrix is composed of a number of individual silicon cells which convert light energy directly into electricity without need for external power supplies. Typical current generated is 300 microamperes for 0.01 square inch of active cell area at 1000-footcandles illumination. Units can be supplied in single cell or multiple cell assemblies and feature fast response time in the order of 10 microseconds.

Circle 668 on Page 19

Automation from crane to customer's office at the Western Maryland

After unloading ore from ship to railroad car, weighman in crane transmits data to yard office for automatic preparation of waybill and other documents.



Teletype Printer in a crane automates ore waybilling

As ore is transferred from ships to railroad cars at Western Maryland's Port Covington docks, a weighman high up in the control cabin of the ore-unloading crane records the lot number, tonnage, and car data on a Teletype Printer. Instantly, this information is reproduced in the yard office in punched tape—starting the automatic writing of waybills by a combination of Teletype page and tape equipment.

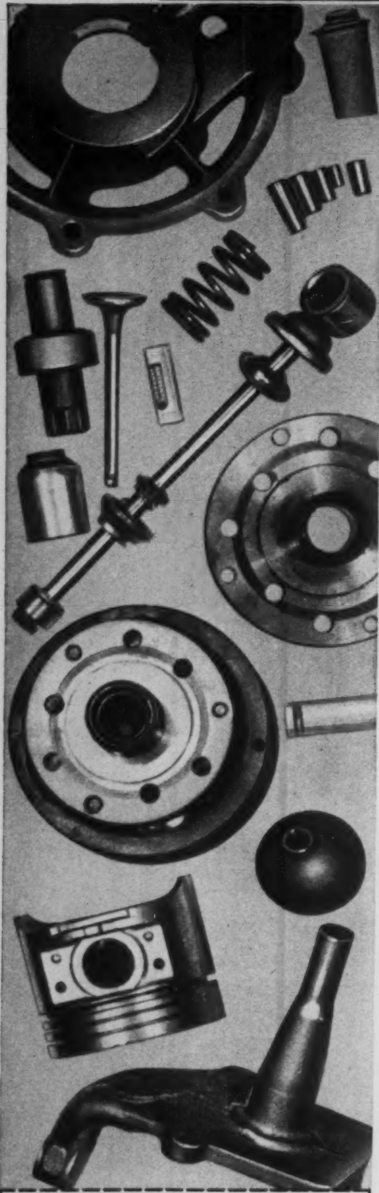
The only manual intervention following the transmission of the variable data from the crane is the association of fixed-data tapes by the yard clerk. The entire procedure takes just minutes—so that when the last car is coupled to the train, all waybills, arrival notices, and consignees' copies are ready. Accuracy is improved, too—since mechanization eliminates recopying errors.

As a by-product of waybill preparation, a master tape is punched automatically, which is used to produce a complete shipping statement. The system also enables the Western Maryland to give customers an extra service to speed their own accounting procedures: advance direct wire transmission of shipping statement data by Teletype equipment or a duplicate of the master tape by mail.

This installation is just one example of how railroads today are using Teletype equipment in new, imaginative ways to trim costs, improve service. This unusual application is made practical by the ruggedness built into Teletype equipment, so that it functions dependably and economically even in the dust-generating environment of ore-loading operations. If you would like information on the new Teletype Model 28 Line, please write to: Teletype Corporation, Dept. 21-J, 4100 Fullerton Avenue, Chicago 39, Illinois.

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company* INC.

practical automation ideas ....#2



GEAR-O-MATION
Division of Michigan Tool Company
7171 E. McNichols Rd., Detroit 12, Mich.

Yes! I want to see the time- and money-saving ideas in your new "Idea File." Have your field engineer show it to me soon!

Name________________________

Company________________________

Street________________________

City________________________

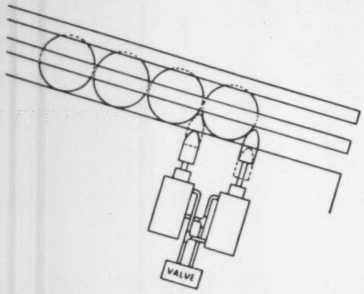
Why Waste Floor Space?

Often a Gear-O-Mation 'overhead' demand storage unit can provide all the in-process storage and demand feeding you need. Can be used between widely separated operations. Tracks of unit are self-cleaning to avoid maintenance up under the ceiling.

Want to see Gear-O-Mation's "Idea File"? Every Gear-O-Mation field engineer has one. Drop us a line and we'll tell the one handiest to your company.

Two Cost Less Than One

Simple twin air cylinders, working alternately can release parts for demand feed at a lower cost, frequently, than a single cylinder with a rocker arm. The arrangement is also more positive and can give faster 'in' and slower 'out' movement to prevent parts jamming or accidental escape.



The Old Town Pump

Many practical automation ideas come from old principles. Example: Use of the old town water pump to elevate parts on demand. Instead of bringing up water, a cage instead of a plunger brings up a part. The cage opens the gates. Elevation is by a simple piston rod.

When it comes to actuating devices—electrical, mechanical, hydraulic or pneumatic—it is Gear-O-Mation's policy to use only proven equipment, thus lessening chances of service interruptions and making sure reliability is not sacrificed.

"Freeway" Interchange for Parts

If you have the need to switch parts on demand from, say, either of TWO 'inbound' to either of two 'outbound' tracks, Gear-O-Mation has a simple way of doing it with air operated gate. Particularly useful where you are feeding two machines from two others.

Flip-Flop Press Feeder

An oscillating arm with built-in hydraulic clamp can pick up a part from the loading chute, load it into a press, reverse it, remove it and place it on the unloading chute or conveyor.

A basic principle at Gear-O-Mation is to look always for the simplest answer to any problem of handling of parts in process. Usually they find it, too. Nine times out of ten, the simplest way is usually the most practical.

2-Strand Chain Does Whole Job

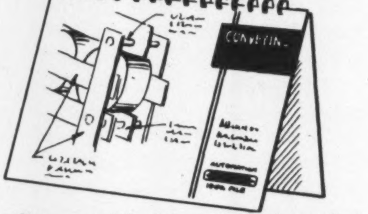
Rotating continuously in a vertical plane, a 2-strand chain with A, B and C pockets receives parts, feeds them into machine 'A' for operation 'A', takes them back, feeds them into machine 'B', gets them back again, feeds them into machine 'C'. Exit chutes into machines serve as loading magazines.

Automating for Worker Safety

Positioning of small parts in relation to large ones in welding or riveting machines sometimes presents a safety hazard to hands. A simple solution is a positioning arm with a formed end which swings into place by simple cam action after the large part is inserted. The small piece is then pushed into position by the machine and the positioning arm retracts, leaving the part in place.

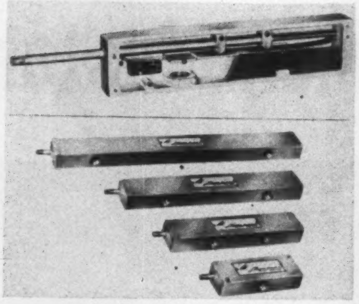
SEE THIS "IDEA FILE"

Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting, feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon at left.



GEAR-O-MATION
DIVISION OF MICHIGAN TOOL COMPANY
7171 E. McNICHOLS RD. • DETROIT 12, MICH.

Circle 670 on Page 19



ENCLOSED electromechanical switching units for electrical control of linear machine movements are available from Linear Controls Co. Unit contains two snap-action switches which are actuated by adjustable cams mounted on a sliding tube as the tube is reciprocated by an air cylinder or sliding machine member. All parts are enclosed within a rigid cast aluminum housing. Five standard sizes are available for stroke lengths of 4, 8, 12, 18, and 24 inches.

Calif. Additional information is available from ASME headquarters, 29 W. 39th St., New York 18, N. Y.

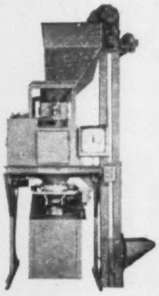
Sept. 21-22—
Standards Engineering Society. Eighth annual meeting to be held at the Somerset Hotel, Boston, Mass. For further information, contact Charles T. Ajamian, P. O. Box 538, Wayland, Mass.

Sept. 21-25—
Instrument Society of America. 14th annual Instrument-Automation Conference to be held at the International Amphitheatre, Chicago. Additional information is available from ISA headquarters, 313 Sixth Ave., Pittsburgh 22, Pa.

Sept. 28-Oct. 1—
American Welding Society. Fall meeting to be held at the Sheraton-Cadillac Hotel, Detroit. Additional information is available from AWS headquarters, 33 W. 39th St., New York 18, N. Y.

Oct. 7-9—
American Vacuum Society. National Symposium on Vacuum Technology to be held at the Sheraton Hotel, Philadelphia. For further information, contact C. B. Willingham, American Vacuum Society, Box 1282, Boston, Mass.

Oct. 12-14—
National Electronics Conference. Sponsored by the AIEE, IRE, Illi-



If you overweigh you lose money...
If you underweigh you lose customers!

Richardson Automatic Bagging Scales are the answer to this problem. They provide high speed bagging with accuracy that eliminates give-away of product, avoids customer complaints of shortweights. Higher production speeds mean reduction in costs, too.

The Richardson E-50 Bagging Scale gives you all these benefits –

Accuracy – within 1 ounce at speeds of ten or more 50-lb. bags per minute!

Versatility – handles weighings from 5 to 200 lbs. of grains, plastics, powdered and granular chemicals, feeds and meals, pellets, sugar, salt, and many others.

Dependability–ruggedly-built for years of trouble-free service.

For full details on the Richardson E-50 and other bagging scales write today.

Richardson Scales conform to U.S. Weights and Measures H-44 for your protection.

Here's the answer...

Richardson
MATERIALS HANDLING BY WEIGHT SINCE 1902

1790

RICHARDSON SCALE COMPANY • CLIFTON, NEW JERSEY
Sales and Service Branches in Principal Cities • Also manufactured in Europe to U.S. standards

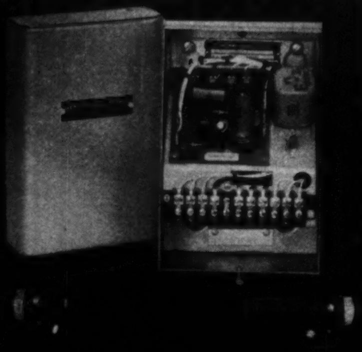
Circle 671 on Page 19

Count, sort, or inspect them faster

Self-contained relay

Low-cost; ideal for limit-switch-type application; includes a SP-DT output relay.

Transistorized relay



Features transistors; hermetically sealed plug-in relay; miniature light source, photocell holders.

General-purpose relay

GENERAL ELECTRIC
Control

A low-cost, highly reliable relay suited to counting, diverting, limiting and signalling jobs.

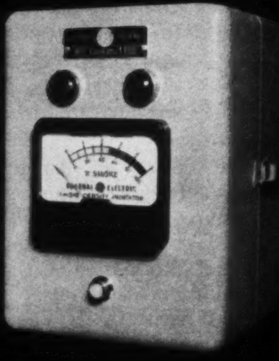
Explosion-proof relay

Watertight, explosion-proof; includes 3-inch lens, self-contained phototube, time delay.

Long-distance relay

Responsive *only* to light from accompanying light source; operates at distances up to 2,500 feet.

Smoke-density indicator

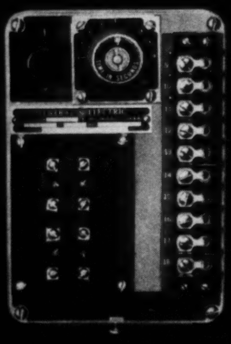


Measures smoke density, liquid turbidity, etc., and provides alarm when pre-set point is reached.

Voltage-sensitive relay

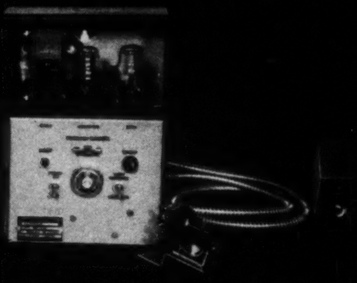
Detects voltage changes for meter operation, elevator-motor overspeed detection.

Electronic timer



Provides time delay of given duration, or set interval simply by setting dial at desired time.

Cut-off register control

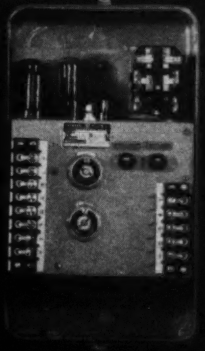


Low-cost; features direct operation of solenoid, small scanner, timed reset and relay kits.

and more efficiently with modern

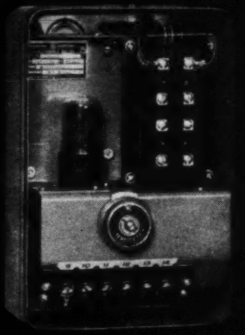
G-E electronic devices

High-speed relay



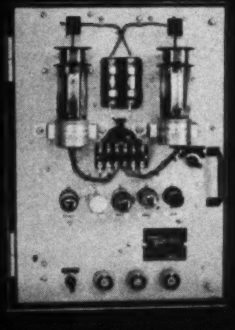
High-sensitivity; fast operating (600 ops. per min.); time delay, interlock, many other features.

Resistance-sensitive relay



Uses resistance changes to control a circuit; can operate motor to maintain liquid between two levels.

Side-register control



Accurately maintains lateral position of moving web in a process or machine; high-accuracy control.

Your General Electric distributor offers a full line of simple, easy-to-use controls

Whether you're automating a production line . . . replacing obsolete machines . . . or, trying to get more out of present equipment . . . one of General Electric's photoelectric or electronic controls may help you gain faster, more efficient production.

Why? Because G-E photoelectric and electronic control devices are specifically intended to take the complexity . . . the labor . . . and the waste out of modern-day production. Combinations of these devices are applicable to virtually any industrial counting, sorting, signalling, protecting, diverting, detecting, or limiting job. And, chances are they will do the job at less initial cost—and lower operating cost—than the control methods you are now using.

CONSIDER THESE EXTRA-VALUE FEATURES

Bonus features you get with job-proved General Electric photoelectric and electronic controls include:

Fast response—Relays operate on light changes as short as 1/1000th of a second.

Versatility—G-E relays operate on light increase, decrease, time delay, reflected light, slow or rapid light change.

Dependability—Lamps operate 3,000 hours or more. Components are conservatively rated for long, maintenance-free life.

If you are not satisfied with the efficiency of your production operations, it will pay you to find out about G.E.'s complete line of control devices. Call your nearby G-E Apparatus Sales Engineer or Distributor. Or, send us the coupon below. *General Electric Co., Specialty Control Dept., Waynesboro, Va.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle 672 on Page 19

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General Electric Co., Section C793-1
Schenectady 5, N.Y.

Please send me a copy of the new G-E Photoelectric Control catalog, GEA-6822, with description, specifications, and pricing data on the complete line.

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Company ______________________________

Address ______________________________

City ____________________ State ____________

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INCORPORATED

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FOR ACCURATE INDEX

AIR CYLINDER CUSHION CONTROL
AIR SPEED CONTROL

HERE'S YOUR ANSWER, if accuracy and dependability are important to you. Cushioned stop eases work to position. Locking cylinder stops the table "on the money" and holds it until released by locking dog. Changes in loads, diameters or speeds are no problem either, since both speed and cushion are adjustable. Top plate is 15" in diameter but the rugged mechanism will handle much larger work loads. Table will make up to 100 indexes per minute with a 22" diameter, 200 lb. load.

OPERATES on 60-175 lbs. pressure when equipped for air but table is available for either air or hydraulic operation. 4, 6, 8, or 12 stations are standard but others, up to 30, are made to order.

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INDEX CYLINDER
INDEX PIN
LOCKING DOG
LOCKING CYLINDER

HEAVY DUTY
air
INDEX TABLE

NO BACKLASH, SKIPS, OVERRUNS

THE REASONS are simple but important: • Positive index, because the index pin shifts to the new position while table is stationary and is only disengaged by locking dog after indexing • Locking cylinder insures firm seating of dog in ring notch • Cushion stop eliminates wracking jar • Two versatile sizes • Table surface is ground for accuracy • May be mounted vertically or horizontally on all types of presses or other tools where accuracy of register is imperative • Operates on line pressure from 60-175 lbs.

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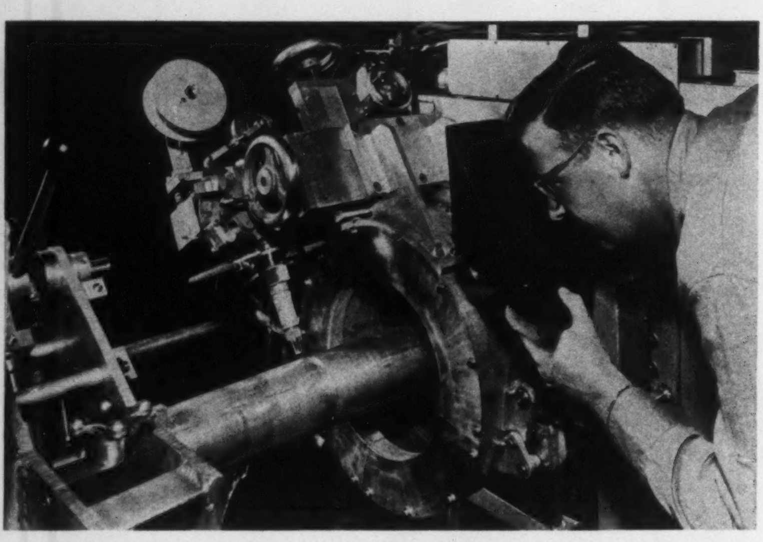
Circle 673 on Page 19



AUTOMATIIC welding machine developed by Aluminum Company of America is designed to weld aluminum pipe having outside diameters varying from 4 to 11 inches. The high-speed unit completes a pass on 4-inch pipe in 11 seconds. The welding head can be set to oscillate, automatically moving back and forth across the weld width to ensure complete filling. The torch can be tilted away from its welding position for fast servicing, without disturbing pipe in the machine. Although primarily designed for welding aluminum products, the machine can be adapted to handle other materials.

nois Institute of Technology, Northwestern University, and the University of Illinois, the conference will be held at Hotel Sherman, Chicago. For further information, contact Hal Bergen, 185 N. Wabash Ave., Chicago 1, Ill.

Oct. 12-14—

Systems & Procedures Association of America. International Systems Meeting to be held at the Royal York Hotel, Toronto, Ontario, Canada. Additional information may be obtained from Dar E. Tisdale, National Headquarters SPA, 4463 Penobscot Bldg., Detroit 26, Mich.

Oct. 19-21—

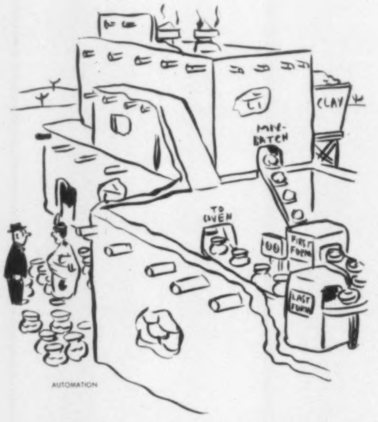
American Institute of Electrical Engineers. 11th annual Machine Tool Conference to be held at the Sheraton-Cleveland Hotel, Cleveland. Additional information is available from E. F. Kimball, Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio.

Oct. 20-22—

Sixth Annual Conference on Lubrication. Jointly sponsored by the American Society of Lubrication Engineers and the American Society of Mechanical Engineers, conference will be held at the Sheraton-McAlpin Hotel, New York. For further information, contact ASLE headquarters, 5 N. Wabash Ave., Chicago 2, Ill.

Oct. 22-23—

National Conference on Industrial Hydraulics. Fifteenth annual meeting sponsored by the Graduate School of Illinois Institute of Technology and the Armour Research Foundation will be held at the Sherman Hotel, Chicago. Additional information may be obtained from R. D. Meade, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Ill.



"Tribal laws forbid revelation of secret method for making pottery so fast and cheap."

A NEW ERA IN RELAY LIFE AND RELIABILITY!

A-B
QUALITY

THEY MAY LOOK ALIKE, BUT

these new relays completely outmode the usual concepts of relay life and reliability.

For years the Allen-Bradley Bulletin 700 Type B and Type BX relays have been preferred for their long life and their consistent, trouble free operation. In having produced millions of these relays, we learned how to improve them. Thus, the new line of Type B and Type BX relays was designed to set a new level of performance standards.

Turn the page and see the outstanding features of these new Bulletin 700 Type B and Type BX relays. For the same price, they offer you even greater value, greater reliability.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
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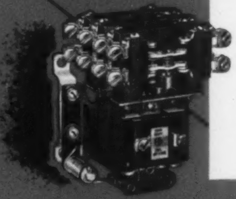
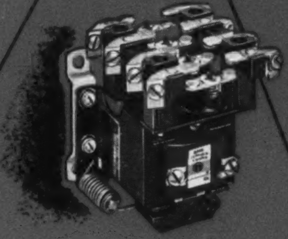
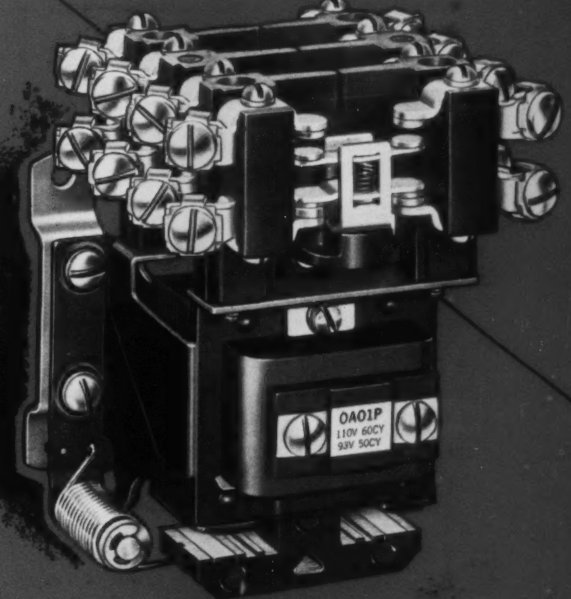


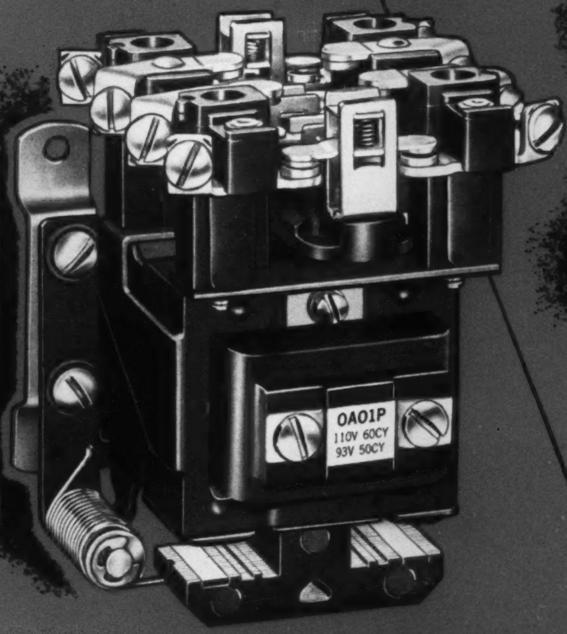
old Bulletin 700
Type BX-440 Relay



old Bulletin 700
Type B-400 Relay
with 4 N.O. contacts



new Bulletin 700, Type BX-440A
AC Control Relay can be wired for normally open or normally closed contacts



new Bulletin 700, Type B-220A
AC Control Relay with 2 N.O. and 2 N.C. contacts

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QUALITY MOTOR CONTROL

7-59-MR

NEW BULLETIN 700 RELAYS

TYPE B AND TYPE BX

provide these improved features

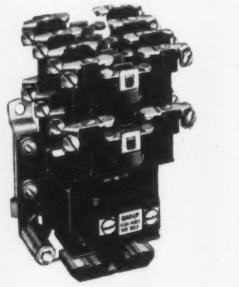
1. New mechanical design gives *at least* 5 times greater operating life.
2. New contact motion provides 10 times greater electrical reliability.
3. Compact construction—new relays are structurally improved with no change in size.
4. Complete interchangeability. Mounting dimensions of new relays have not been changed.
5. Rugged, high efficiency cast plastic coil. New, improved coil fits *all* Bulletin 700 relays.
6. New, stronger, movable contact crossbar—fits Bulletin 700 relays now in service.
7. Improved stationary contact blocks. These new blocks can also be used on present models of the Bulletin 700 relay.
8. Increased life and reliability—*no increase in cost.* These new, improved relays are priced the same as previous Allen-Bradley models.
9. The letter A is added to the Bulletin 700 relay type number merely to distinguish the new line.
10. These new relays are Allen-Bradley's "thank you" to our many customers who have bought millions of Bulletin 700 relays over the years.

A-B
QUALITY

The old Bulletin 700 relay was first placed on the market some 25 years ago. Today, millions of these relays are in daily service—all over the world.

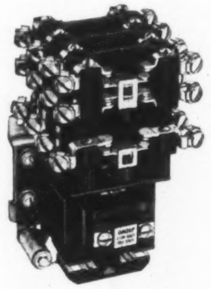
None of the old relay "values" have been lost in the new designs. Instead, these "values" have been greatly improved. The new relays feature a simplified, longer life, solenoid construction. The double break, silver alloy contacts are the same—always in perfect operating condition—without cleaning or filing. The operating coil has been greatly improved—it cannot be damaged by atmospheric conditions, no matter how severe.

No one can deny the popularity of the older Bulletin 700 relays. The new relays—with their superior features—will be an even better answer for any and all relay applications.



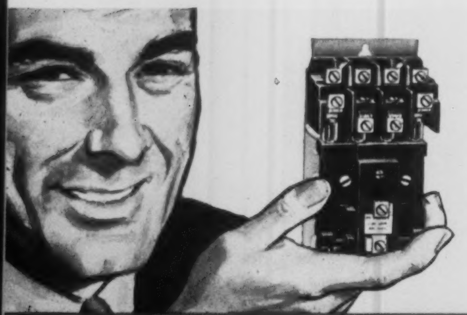
TYPE B, GENERAL PURPOSE

Bulletin 700, 8-pole relay. Made with 8 N. O. and no N. C., or up to 4 N. O. and 4 N. C. contacts.



TYPE BX, UNIVERSAL

Bulletin 700, 8-pole relay with both N. O. and N. C. contacts. Changeover is made by reconnecting incoming lines.



HERE IS ANOTHER REMARKABLE ADDITION TO THE ALLEN-BRADLEY RELAY LINE

It's new . . . and it's different. This unusual Bulletin 700 convertible contact relay has contacts that can be changed from normally open to normally closed operation (or vice versa)—in just moments. A screwdriver is all it takes to do the job—no additional parts are needed. Like all A-B relays, it's good for millions of trouble free operations. Watch for announcement and full details of this new convertible relay soon!

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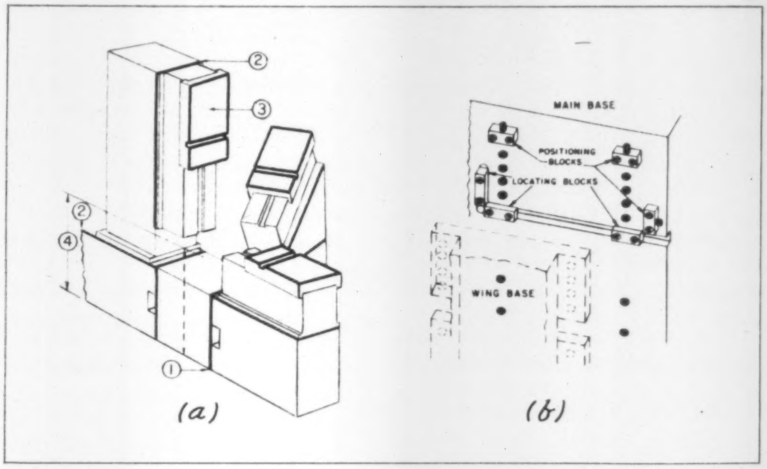
7-59-MR

QUALITY MOTOR CONTROL

detroit dateline

By **JAMES C. KEEBLER** Managing Editor



Sketch (**a**) indicates by bold lines the areas of standardization for mounting dimensions and work height of components and units of production machine tools. 1. Wing base attaching surface. 2. Feed unit mounting surfaces. 3. Saddle mounting surface. 4. Work loading height. Sketch (**b**) shows fitted key method of attaching wing base to main base.

Defining Status Quo

SEMANTICS is defined as the science of meanings, as contrasted with *phonetics,* the science of sounds; the historical and psychological study and the classification of changes in the signification of words or forms, viewed as normal and vital factors in linguistic development.

Said a Mouthful

We are indebted to a Mr. Charles White for an enlightening lunchtime discussion of semantics. Mr. White is a graduate in Creative Writing and gainfully employed by Ed DeWitt, president of Wallace Supplies Mfg. Co., to advance the state of the firm's business by advancing the employees' ability to use words. These people work on both ends of the problem: speaking and listening. The whole program is fascinating indeed, and we were intrigued with the ideas presented.

Some of the byroads of this subject are as interesting as the main avenues of thought. One of them that made a lasting impression was the consideration of the differences between *semantics* and *general semantics.* One should really be a qualified *semantician* to indulge in this sort of escapade, but the layman's guide to the delicate differentiation would make statements to the effect that the modifying word "general" narrows the field into a more specific area and therefore it can be said that *semantics* is more general than *general semantics.*

Before reading any of the recommended references on the subject, the dilemma caused by this minor exertion of mental gymnastics recalled for us a similar encounter with the definition of *status quo.* Rather than risk the complications of further enlightenment, the subject was shelved.

Courage Required

Recent developments have encouraged us to set aside this cowardice and acknowledge that much of the world's progress has been credited to those who dared to be dissatisfied. So we'll dust off the books and reopen an issue or two before we're through.

The old status quo ploy goes like this: Trapper: He was a real innovator, quite well adjusted, and satisfied with the status quo. Game: How can an innovator be satisfied with the status quo? Trapper: He defines status quo to encompass all of the circumstances of the present situation including his present plans to improve the horrible mess we're in.

It may be that the dictionary could be interpreted in such a way as to uphold this inclusion, but the semantician would probably have to agree that until he gets the gagline verifying he's being bamboozled, Game has every reason to believe no real innovator is ever satisfied with the status quo.

Considering the number of manufacturing problems crying for improvement it would probably be safe to state that no one should be satisfied with the status quo unless it is so redefined.

Block Building

One of the recent significant announcements of improvement was the report by Henry C. Daum, manager of Ford's machining process department and chairman of an industry study committee, stating that manufacturing firms and major production machine suppliers have reached accord on a limited series of standard specifications for "building block" design of dial and in-line types of automotive transfer machines.

Great credit should go to Henry Daum and the rest of his committee for this major feat of diplomacy. The complexities of achieving such accord are such as to challenge the talents of a John Foster Dulles.

Ford's manufacturing engineers were (and still are) at liberty to set specifications on any and all equipment purchased for the manufacture of the product. They could have gone it alone, but the goal they chose was to gain long-range cost savings by getting industry cooperation. If various builders and various users were to offer and specify building block components with the same mounting dimension specifications, greater flexibility at less cost would be the prize for all.

To those who automatically consider that a suggestion of changes means a condemnation of their previous accomplishments, the idea of revising a builder's already existing dimensional scheme of blocks was likely to meet with violent disfavor, even disregarding the cost of change.

To those whose fame and fortunes were built on their ability to design production equipment the idea of a user group suggesting standards to the industry might be viewed as highly presumptuous.

To those who think that standards stifle progress and limit ingenuity of design, the need for cooperation would probably not be apparent.

Associate Action

To the uninitiated this might seem like a job for an association. Standardized machine components would provide a degree of interchangeability hitherto unknown and promote more rearranging of production facilities with the by-product effect of creating more business for the industry. An association, however, did not take over the project, nor are the resultant standards being disseminated by any technical society.

Apparently one reason for no official participation was the fear of Justice Department action if a group of sellers makes a deal with a group of buyers. The mores and machinations of association, legal, judicial, and corporate activity are so intertwined that the list of reasons is no doubt longer than this manuscript. We have progressed to the state where it takes a highly trained semantician to make a clear differentiation between technological advancement and collusion in restraint of trade.

Policies of associations favor selling the customers what they want to buy, but this organized effort to determine appropriate dimensional standards that describe components of machines was prepared by negotiations with individual builder companies rather than by action of the committees of any duly constituted association. Some say this is the quickest and best way.

It is a marvel of dedicated perseverance that the printed standard appears as a consensus of opinion in view of the many special-interest factions existing. The printed standard bears no identification with any company or any previously recognized group of standards makers. The symbols of all standards writing committees are conspicuous only by their absence.

If this is the quickest and best way it is either a poor testimonial for those groups whose organizational purposes include the issuance of such standards or a vote of no confidence in the need for this standard. To date we have not heard anyone who really believes the latter.

Because it was not sponsored by a standards organization, the issuance of this standard represents the culmination of an effort in which the mission has been accomplished and the meeting adjourned without setting a date to reconvene.

Quo, Quo, Quo . . .

The status is now quo. It is hard to believe that those 16 user companies and 26 builder companies, who dared to be dissatisfied with the status quo ante bellum and subscribed to the concepts that brought forth this standard, will long be satisfied with the present state of the art of devising machinery.

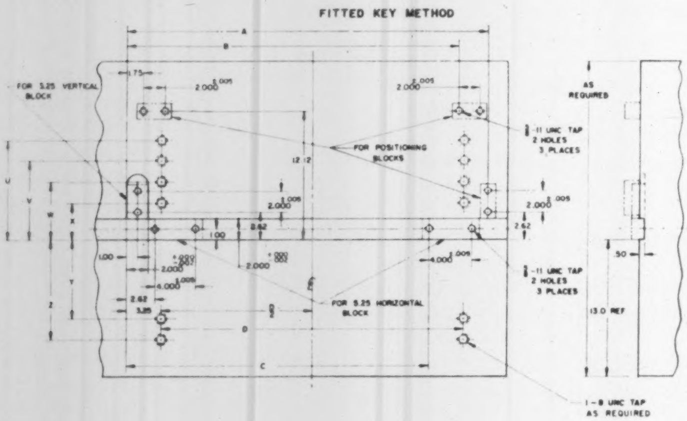
The status is now quo. There is a need to increase the useful life of high-priced production facilities, yet to be able to quickly revamp them for efficient manufacture of changing product lines.

The status is now quo. The issuance of standard mounting dimensions for building block components represents a milestone of progress, but like all previous standards cannot be expected to remain valid without amendment in the face of technological progress spurred by innovators determined to improve the status quo.

The status is now quo. Any purchasing department that categorically adheres to this (or any other standard) as a ceiling on design improvement rather than as a floor, covering poor practice, will defeat the major premise of the standard's formulators. Only by analytical engineering interpretation of proposals will the standard's words,". . . not intended to inhibit or restrict the art of machine design or mechanical engineering," have meaning to the user. Nonstandard design is not necessarily bad design.

The status is still quo. Production equipment and components need a whole family of standards that uphold the high level of design accomplishment, provide a basis on which to build better facilities, and are periodically reviewed to maintain their validity. This job should not be left to individual companies.

Those of our readers who wish to applaud Daum and committee for this accomplishment can join the cause by getting a copy of the new standard and putting it to work. Copies are available by writing Mr. Henry C. Daum, manager machining process dept., Ford Motor Co., The American Road, Dearborn.



Drawing of bolt hole and keyslot pattern established as standard fitted key method of mounting wing base to main base.

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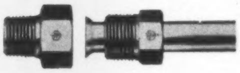

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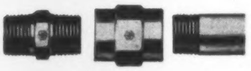

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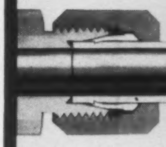

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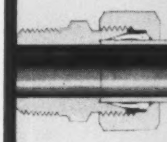

"8000" SERIES ERMETO®
Listed by U.L. for use with hazardous liquids, fuel equipment, refrigeration and gas; meets specs of S.A.E. and J.I.C. hydraulic tube fitting standards. Supplied as standard in cadmium-plated carbon steel and in stainless steel. Requires no flaring. PRESSURE RATINGS: up to 10,000 p.s.i. **Size Range—⅛" through 2".**

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37° FLARE STEEL TUBE FITTINGS
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FLARE-TWIN
Made in 3-piece and 2-piece assemblies. 2-piece type offers price advantage. "Weathercote" or cadmium-plate finish.

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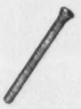
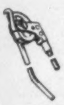
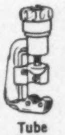


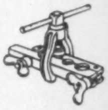
Spring-Type Bender



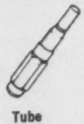
Mechanical Bender



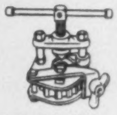
Tube Cutter



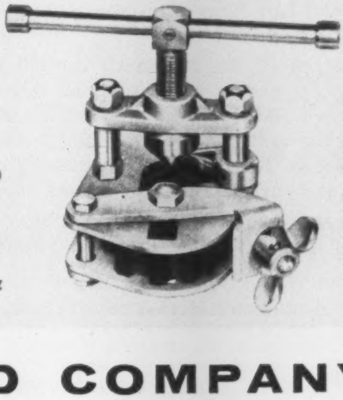
Bar-Type Flaring



Tube Swaging



Automatic Flaring Rotary



New rotary flaring tool for perfect tube flaring. Fast . . . one piece construction. Easier . . . "Dial - Matic" tube size selection. Accurate...tube stop automatically controls flaring diameter. Compact . . . easy to store. Available with burnishing attachment.

THE WEATHERHEAD COMPANY

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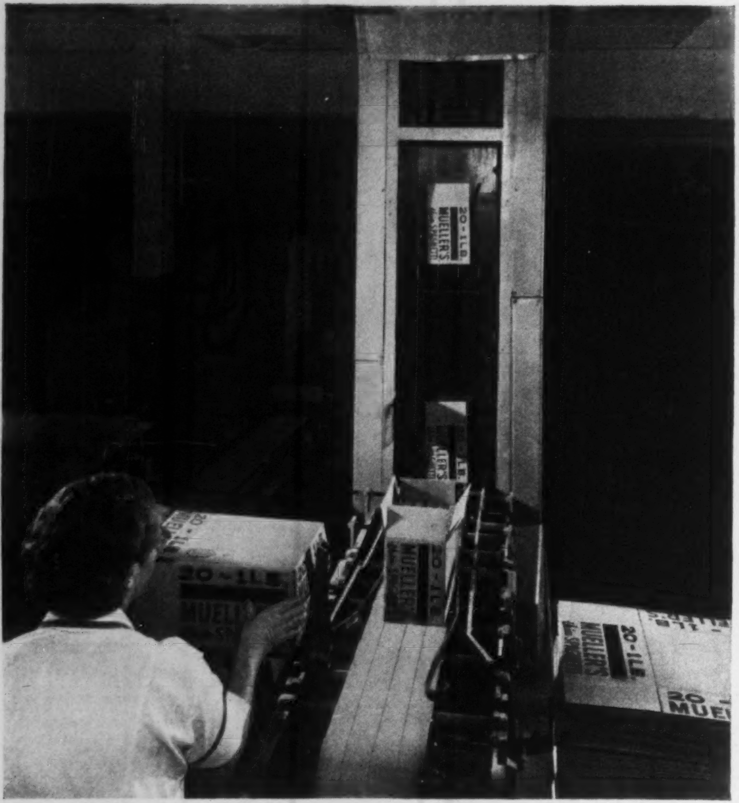
Circle 674 on Page 19



Space-Saving Tray Elevator Boosts Mueller Production!

Because this Robo-Lift Tray Elevator ascends straight up, C. F. Mueller Co., Jersey City, increased production without costly remodeling. To cope with stepped-up consumer demand, the nation's largest macaroni manufacturer rearranged and increased the capacity of its product weighing, packaging, cartoning and sealing operations. To hike the output, engineers placed the automatic sealing unit high above floor level. However, due to cramped quarters, a vertical elevator was needed to carry product-filled cartons to the sealer.

Only the Lynch Robo-Lift Tray Elevator met all requirements and specifications.

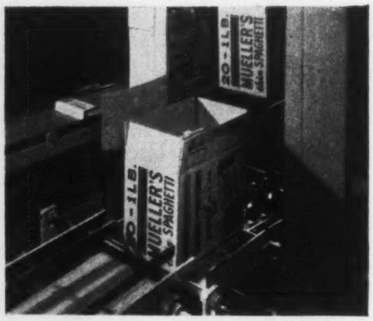
Space-saving and jam-proof, the automatic upright operates a sixteen-hour shift, handling cartons at the prescribed rate of six-per-minute. Featuring unique infeed and discharge systems, the elevator cannot jam—ever. And, unlike bar and belt-type models, it doesn't mar or rub a carton's printed message. Through fixed positioning of trays, pendulum action is eliminated and cartons ride safe, secure, easy.

Robo-Lift Tray Elevators are available for a variety of lifting or *lowering* assignments. For full details on how Tray Elevators serve, request free literature, today.

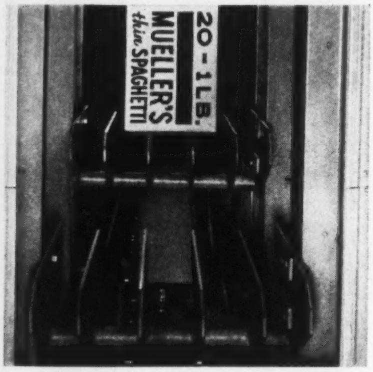
Write for illustrated booklet which details the complete story titled, "LYNCH Robo-Lift Tray Elevator . . . moves cartons vertically, saves time, money, floor space at C. F. Mueller Company."

Lynch Corporation—*Manufacturing Engineers of automatic processing equipment for the glass, packaging, plastic and other industries.*

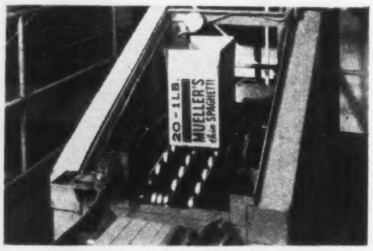
Atlanta · Chicago · Wallington, N.J. · Kansas City, Kansas · San Francisco



Close-up shows a filled carton beginning its gentle Tray Elevator ride upward. In the foreground, the next carton in line has moved off conveyor belt and is automatically held back until oncoming tray appears.



Moving straight up, the carton rests on a fixed, non-pendulum tray that neither swings nor sways . . . always holds carton steady, secure. Note how carton's open end bottom is held in a closed position until it reaches the sealing unit.



Just beneath the room's ceiling, the carton leaves the tray via rollers. Conveyor belt then takes over, moving carton through the sealing operation. Although a six-per-minute schedule is timed here, the elevator can move up to 15 cartons every minute.

LYNCH
CORPORATION
Anderson, Indiana

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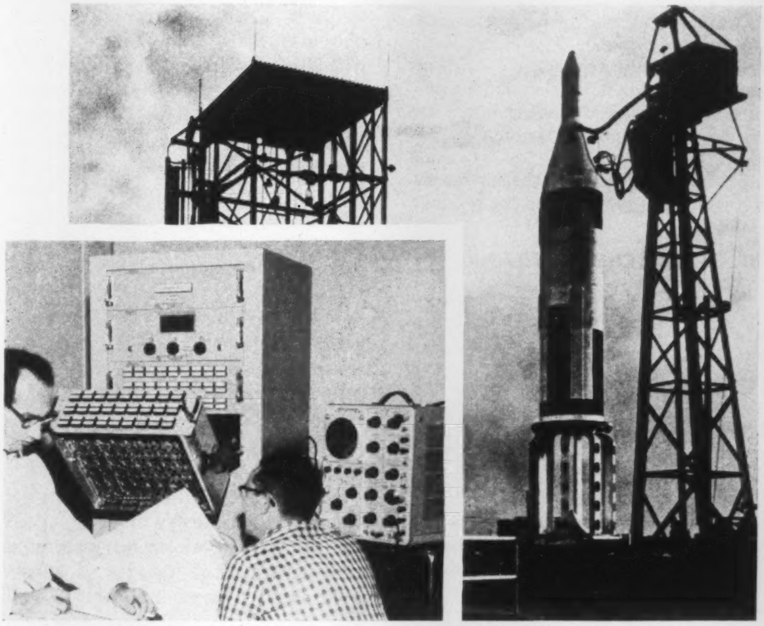
western trends



Constructed for the Missile and Space Div. of the Lockheed Aircraft Corp. by Magnetic Amplifiers Inc., the illustrated sequencer provides control of other missile ground checkout equipment. The unit—containing only static devices—issues commands, compares information received in response to its orders, and verifies accuracy of test results. The static sequencer has potential industrial application in the fields of equipment testing, data handling, food processing, and automated machinery.

The Money Value of Time

FROM a practical viewpoint, all the money expended on research and development has no effect on industrial progress until those things researched and developed are put into use. Many observers of the industrial scene have noted, with varying degrees of alarm, the ever-widening gulf that separates the apparent availability of new things and the general use of new things. Whatever the cause, the effect is of considerable importance to the West Coast, abounding as it does in talent dedicated to the development of the new.

Where a gulf does exist, a safe assumption is that the cause must be shared by those that develop and those that could use the products of development. And here it should be noted that "products of development" refers to production techniques, as well as component and equipment items.

So far as the developers are concerned, there are those situations in which development hasn't been carried to the point where general industrial application is obvious, or where the requirements of industry in general are included in the design, or where the proper people in industry are made aware of what it is that a development offers. This picture can be improved from the developers' side by broader industrial experience and a greater sensitivity to the special needs of industry, industrial buying habits, and channels of communication.

Concerned as they are with such factors as customer reaction, performance, costs, labor relations, etc., potential users of new products or techniques understandably require time in which to evaluate those things offered to them. Even the best evaluation for capital expenditures contains an uncertainty factor—for the simple reason that future time is a parameter in an evaluation. This suggests to the would-be user that caution is a wise course of action; caution is easily translated into a policy of "wait-and-see"; and the gulf between availability and general use widens.

Considering the factors which underlie our economy and the percentage distribution of costs in a typical manufacturing plant, it is not too strange that wide-awake industrial users have been able to skirt this general "wait-and-see" philosophy and derive a competitive advantage.

The trick has been to create the means for speeding up development and evaluation of new production techniques. In this, these manufacturers have proved themselves to be astute interpreters of the basic lesson taught by one of the earliest and best known industrial leaders of the Twentieth Century. The essence of F. W. Taylor's philosophy was that there is a money value to time—and that the value can be obtained by intensive research, planning, and organization by management.

The suggestion that production means might be improved at a faster rate is, to some, synonymous with the suggestion that management might obtain a higher rate of return on an investment at Santa Anita or Hialeah Park. And having mislabeled the basic thought, it becomes easy to miss the boat.

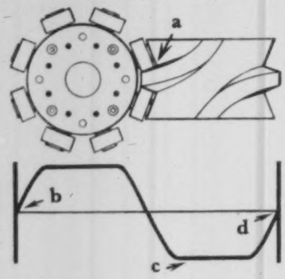
The modern practitioner of manu-

DESIGN CONSIDERATIONS

Critical Points in Acceleration Characteristics of Indexing Devices

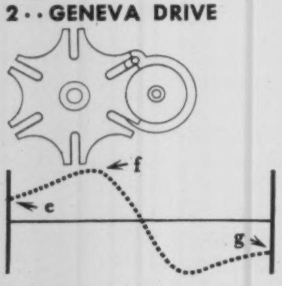
Maximum speeds of production machines are frequently affected by performance limitations of their indexing mechanisms. The efficiency of the indexing mechanism, itself, is dependent upon the amount of shock, vibration and other dynamic forces involved in the starting, stopping and rate of change from maximum acceleration to maximum deceleration.

FIG. 1 · · FERGUSON DRIVE



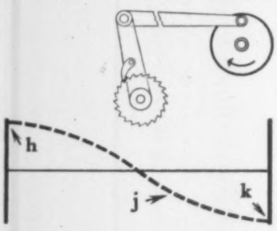
The acceleration curves of such mechanisms provide a graphic means of evaluating and comparing dynamic conditions that affect the performance of the indexing device and the machine. The Ferguson Drive in Fig. 1 is a cam indexing mechanism employing preloaded bearing followers rolling along a tapered cam rib. Two followers are in contact with the rib at all times (a) maintaining a zero backlash condition and an accuracy of .001" without auxiliary locating devices. This Drive features a modified trapezoid acceleration characteristic . . . a combined cycloidal and gravity curve. The Ferguson Drive has an initial force of zero (b) and a smooth, sinusoidal increase. Its maximum acceleration value (c) is very low and the change through maximum deceleration to zero (d) is gradual. These smooth indexing characteristics of the Ferguson Drive permit operation of production machinery at speeds as high as 2,000 RPM, if necessary, with a minimum of 8,000 hours operation while maintaining extreme precision and zero backlash.

FIG. 2 · · GENEVA DRIVE



The six-stop geneva drive shown in Fig. 2 is representative of the geneva family in that its dynamic forces are instantaneously applied and the initial acceleration force is fairly high (e) with an even higher maximum acceleration (f). The change to maximum deceleration is gradual but there is an almost instantaneous stop (g). When operated at high speeds, geneva drives wear out quickly and cause heavy vibrations that seriously affect the life of the machine and product quality.

FIG. 3 · · RATCHET & CRANK



The rachet and crank has a distorted cosine acceleration curve (a true cosine curve is illustrated in Fig. 3) with an extremely high initial acceleration (h). The descent to maximum deceleration (j) is gradual but, as with the geneva drive, stopping is instantaneous (k). Even with auxiliary braking action, overtravel is extreme and accuracy is very poor. Rachet and crank devices have very limited use in modern production machines.

FIG. 4 · ·

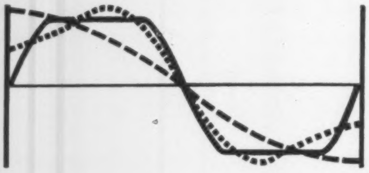


Fig. 4 shows the curves of the three mechanisms on the same diagram. Note that only the Ferguson Drive has an initial force of zero and the lowest maximum acceleration value combined with a gradual change to maximum deceleration. *This is why the Ferguson Drive does what no other indexing device can do!*

• SEND FOR CATALOG

Complete information about the Ferguson Drive is available in the form of an easy-to-use catalog containing load ratings and dimensions of many standard units, drawings and installation photos. There is a copy for every design engineer . . . for your copy write: **Ferguson Machine Corp., 7818 Maplewood Industrial Court, St. Louis 17, Missouri.**

facturing engineering is even more vociferous in condemning the gambling approach to equipment purchases than the best of the old-line, hard headed, dollar and sense buyers.

The modern practitioner preaches: That in our sophisticated industrial society—with its stiffer competition, militant unions, and rising costs—only a superior production capability will distinguish the successful from the failures; that the production equipment in a plant is so important, and nowadays so complex, that it cannot be allowed to grow like Topsy; that management must continually improve its production effort by every means its genius for organization and efficiency can devise.

Whatever the form such an energetic manufacturing organization takes, one of its most important functions will be to continually relate developments to its own production problems. In this respect, canny manufacturers have come to realize that the peculiar requirements of the defense industry tend to speed up normal development processes, not only in the design of space-acclimated components and gadgets but also in the development of production techniques and materials.

In some instances, direct government support has been aimed primarily at the development of superior production techniques with revolutionary implications for industry in general. The outstanding example is numerical controls for machine tools.

Beginning on page 73 in this issue of AUTOMATION is a discussion on automatic testing of weapons systems—a technique that could be as important to industry as numerical control. It is another example of what some are doing today that most will be doing tomorrow.

In some applications at the present time semiskilled technicians are checking out electronic equipment on airline planes with an automatic circuit tester. Voltages, impedances, resistances, continuity, leakage, gain, and phase relationship can be tested. A circuit by circuit check of a plane's electronic gear may only take a matter of minutes, compared to the hours previously spent by a skilled man with a book of specifications, a voltmeter, and a handful of test connectors.

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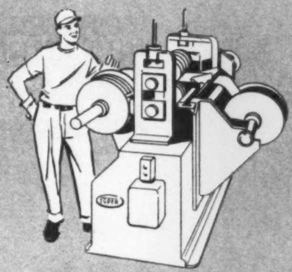
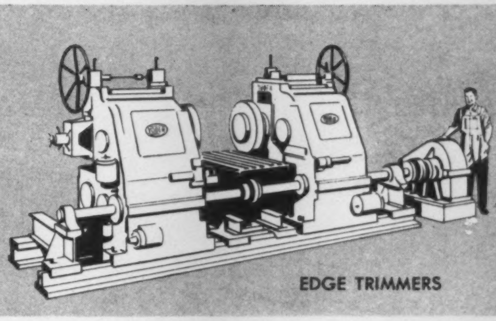
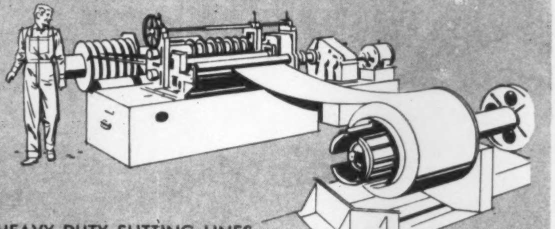


SELF-CONTAINED SLITTERS



EDGE TRIMMERS



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YODER SLITTERS

basic equipment for cost-conscious users of strip!

To help meet the demands of tight production schedules, YODER Slitters reduce mill-width stock quickly and economically to desired widths. If your needs are as low as 100 tons per month, time and manpower savings alone will offset the cost of your YODER Slitter in a matter of months, while reducing basic inventories. Compactly designed, standard YODER Slitters are built to handle standard coil widths . . . completely engineered lines for special requirements.

YODER accessories, such as coil cars, swivel unloaders, scrap choppers, scrap disposers, plate levelers and coil boxes, make stock handling fast and easy.

YODER also makes a complete line of Cold Roll-Forming equipment and Pipe and Tube Mills. To profit from YODER'S years of engineering and service experience, contact your local YODER representative or send for the fully illustrated descriptive, YODER Slitter Manual; it's yours for the asking. Write to

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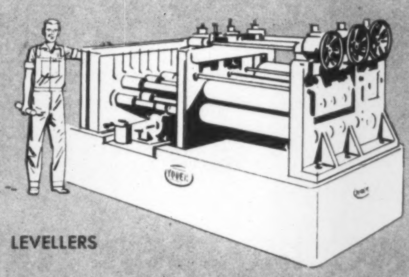
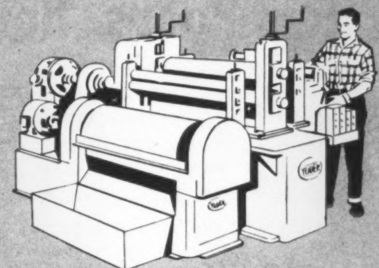
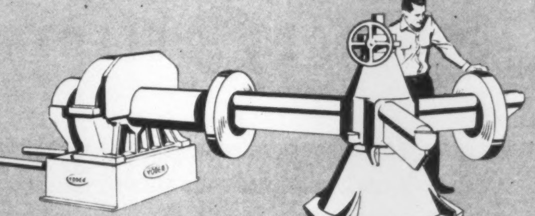


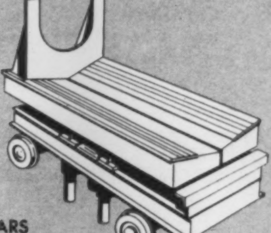
LEVELLERS



SCRAP CHOPPERS



3-ARM UNLOADER

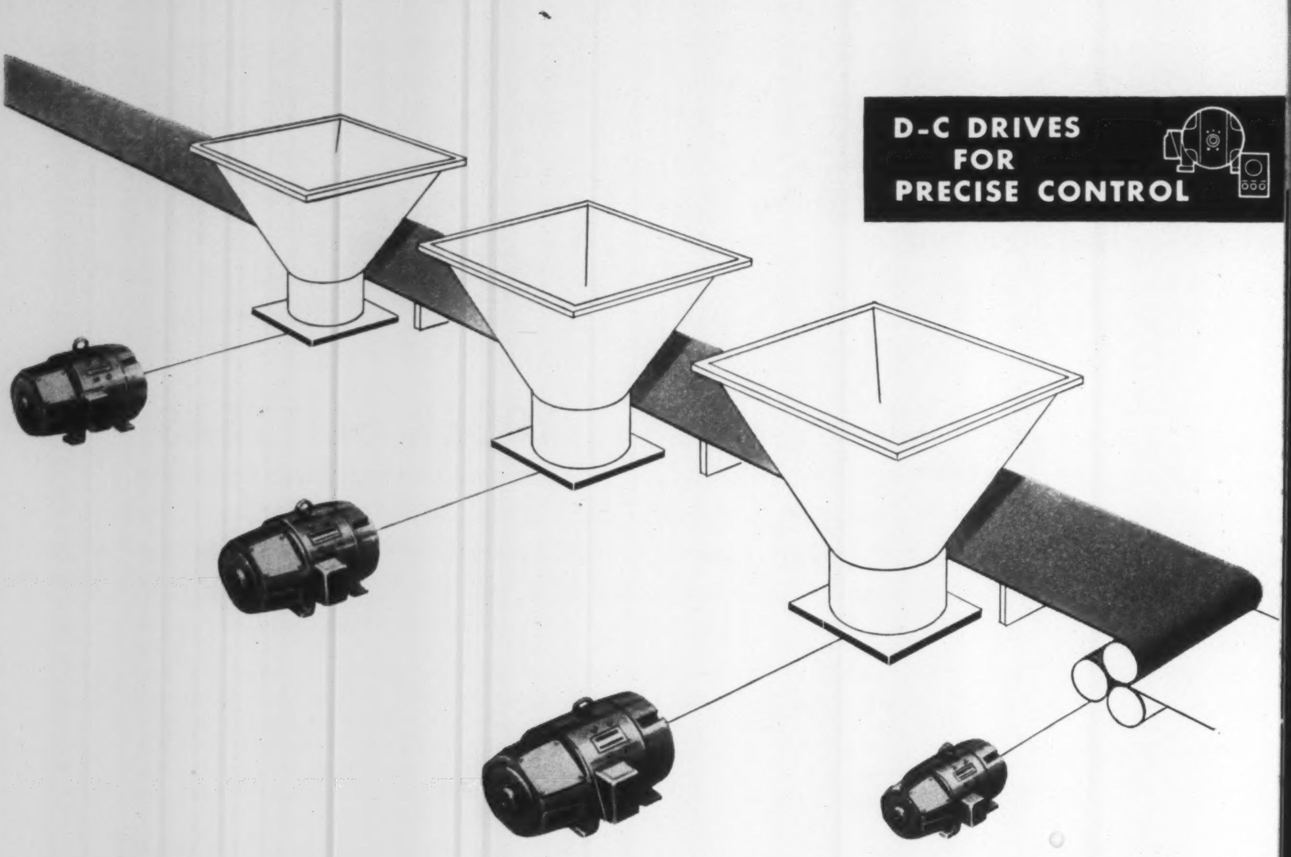


COIL CARS

ENGINEERING
YODER
MANUFACTURING

ROTARY SLITTING LINES

PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES



Problem: How to control machine speed ratios for accurate proportioning, continuous flow

Keeping the blend accurate in proportionate mixing requires a high degree of machine coordination. Inaccurate speed matching of mixers or conveyors can result in poor product quality, inaccurate measure, wasted material.

ACCURATE SPEED MATCHING IS A NATURAL JOB FOR DIRECT-CURRENT POWER. For only direct current can provide the split-second response, wide speed range and precise control vital to modern, automatic machines.

If you are planning to upgrade your production facilities to make processes more automatic, it will pay you to investigate the role direct current can play. A new booklet, "WHY D-C?," is available to help you. For your free copy, write *Section 829-2, General Electric Company, Schenectady 5, N. Y.*

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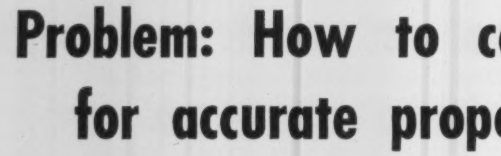
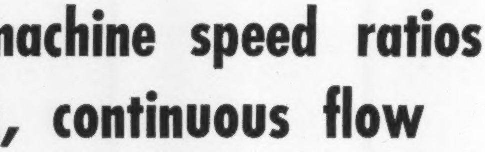


MOTORS AND GENERATORS



POWER UNITS AND CONTROLS

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AUTOMATION

SEPTEMBER 1959

A Second Look

A million cycles before failure sounds mighty impressive to the casual observer of the automation scene. Ten million sounds almost phenomenal. Many basic controls offered today fall into these categories and rate outstanding merit in the eyes of engineers developing automated equipment.

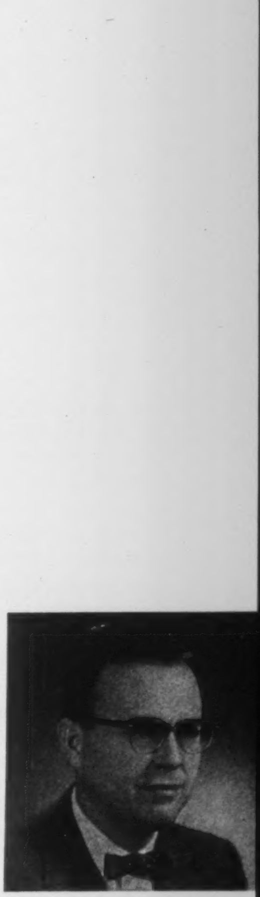
Even with such duty ratings, process downtime traceable to these critical control elements can be distressing. Careful study reveals some often overlooked facts.

Products coming off a line at a mere 100 per minute, on a one-shift basis, operate switches over a million times a month. Another line, cycling at fifteen times per second, on the same basis, actuates the controls some 9 million times! Under such conditions the rosy look of conventional duty ratings and reliabilities fades rapidly.

Newer and more sophisticated controls and devices being developed for automation all too easily command major attention. Nevertheless, many of the small and more commonplace controls such as switching devices, solenoids, relays, and similar components are still indispensable. Perhaps often overlooked as seemingly unimportant in the unfolding automation picture, these controls still account for much of the production downtime losses today.

As an example, a study of electrical maintenance by L. S. Thomas of Pontiac shows that four sources accounted for 60 per cent of the downtime problem: Limit switches 28.5 per cent, solenoids 19.5 per cent, relays 8 per cent, and defective wiring 4 per cent. Limit switches with lab ratings of 3.5 million operations before failure averaged only 650,000 cycles under actual operating conditions.

Without question, greater care exercised in the installation and environment of these control devices will substantially improve service life. However, with the continual advances in the speed and number of operations, it behooves control builders to give a second look toward improved design in these "workhorse" elements of automation.



EDITOR

MANUFACTURING ENGINEERING

• OPERATIONS • EFFECTIVENESS • FUNCTIONS • ORGANIZATION

Manufacturing engineering today requires the combined efforts of a team of specialists equipped by training and experience to evaluate, conduct, and follow up manufacturing programs on a co-ordinated basis. A formalized planning approach ensures that no important technical or economic factors will be overlooked, while proper organization establishes clear lines of responsibility and sets the stage for co-operation among manufacturing engineering, product design, and shop groups.

By **T. R. BUNNELL**, Manager of Manufacturing Services
Semiconductor Div., Sylvania Electric Products Inc., Woburn, Mass.

PROBABLY the most significant step in the growth of an industry is the one in which primary emphasis changes from product engineering to manufacturing engineering. For as an industry matures, and competing product designs tend to stabilize, those companies who desire to remain in business must develop competitive methods of production. Manufacturing engineering thus becomes the keystone of the profitable manufacturing organization. A review of the functions and operations of manufacturing engineering, its place in the over-all organization, and the performance measures which may be used to evaluate its contributions, will assist in delineating the profit-making potential of this important group.

Manufacturing Engineering Functions

A primary mission of a manufacturing engineering group is to specify facilities and methods for fabrication, assembly, inspection, and packing of products so that their cost-quality-time-profit relationships are optimized. This objective imposes responsibility for proposing original and improvement programs; evaluating manufacturing alternatives; and designing, constructing, and debugging of all production equipment from simple jigs and fixtures to automatic machines and complex, integrated lines.

In order to carry out these responsibilities, manufacturing engineering needs know-how in the fields of electronic, industrial, material, mechanical, and specification engineering. Only an organization that provides for this full range of services can properly be considered a manufacturing engineering group because an engineering background is a prerequisite in areas such as specification, cost analysis, methods studies, and mechanical and electrical design.

In specifying production facilities, for example, more is expected of the manufacturing engineering group than the judging of equipment on its technical merits alone. It is possible that an automatic machine that outperforms other equipment productionwise may not represent an optimum choice when time, cost, and profit are considered. Decisions of this type require careful engineering analysis by a team of qualified personnel.

A clear distinction may be drawn between manufacturing and product engineering. Basically, product engineering is concerned with inventing or designing functionally suitable, marketable products with careful concern for appearance, fits, operation, materials, and finishes. In industries which are in a developmental state, the product engineer may specify certain processes and process limits. Usually, however, this practice is confined to process steps or conditions that are essential to ensure that materials will combine to give a desired end result. Examples are crystal growing temperatures, alloying times, and etchant solution formulations in electronic component manufacture.

Manufacturing engineering, on the other hand, establishes processes and provides equipment to make the product in the scheduled quantities, to specified quality levels, at lowest possible cost. Frequently, manufacturing experience permits this group to suggest product design changes that lead to improved manufacturability.

▶ Company Structure

What position should manufacturing engineering occupy in the over-all organizational structure? Since emphasis is on manufacturing methods, it fits logically in the Manager of Manufacturing and Engineering organization, *Fig.* 1. With this structure, a close tie-in is established with production people. This is important, since the success of most equipment programs depends heavily upon the relationships developed between the manufacturing engineers who design and deliver the equipment and the production people who operate and service it. From the manufacturing engineering standpoint, there are two strong reasons for developing close relations with the production group:

1. Shop people, who have daily contact with manufacturing problems, are often in a position to contribute key methods improvement suggestions. However, as production methods become more refined due to increased automation, shop people have less to say in determining these methods. A close working relationship between the two organizations—manufacturing engineering and production—will then help in securing the benefits of shop know-how.

2. Shop people can make or break a program during the initial run-in and debugging stages. Where production people are convinced that a new machine will assist them in performing their job, wholehearted co-operation may be expected and the installation will probably be successful. But where production people can see no particular improvement of their job, the chances of success will be greatly reduced.

The organization chart, *Fig.* 1, shows that a staff relationship exists between the managers of product engineering and of manufacturing and engineering. Since the manufacturing methods which must be followed later depend greatly on the product design, manufacturing engineering representatives should be present during the product development stage. At this time, manufacturing engineering can advance suggestions aimed at improving the manufacturabili-

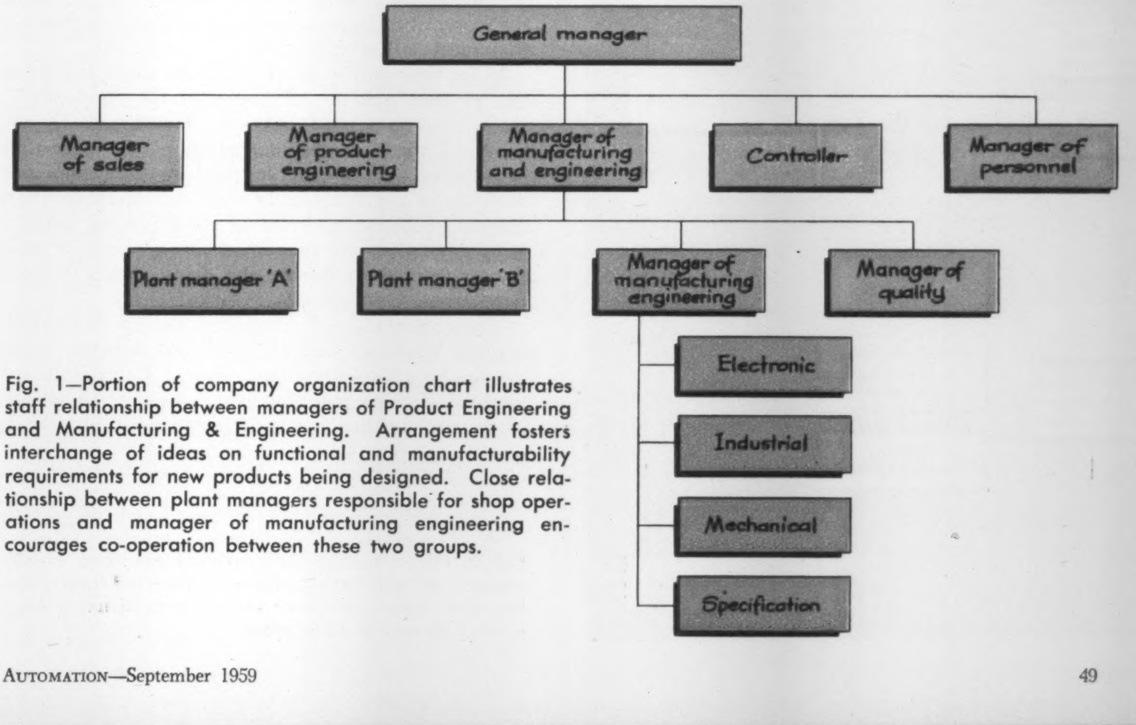
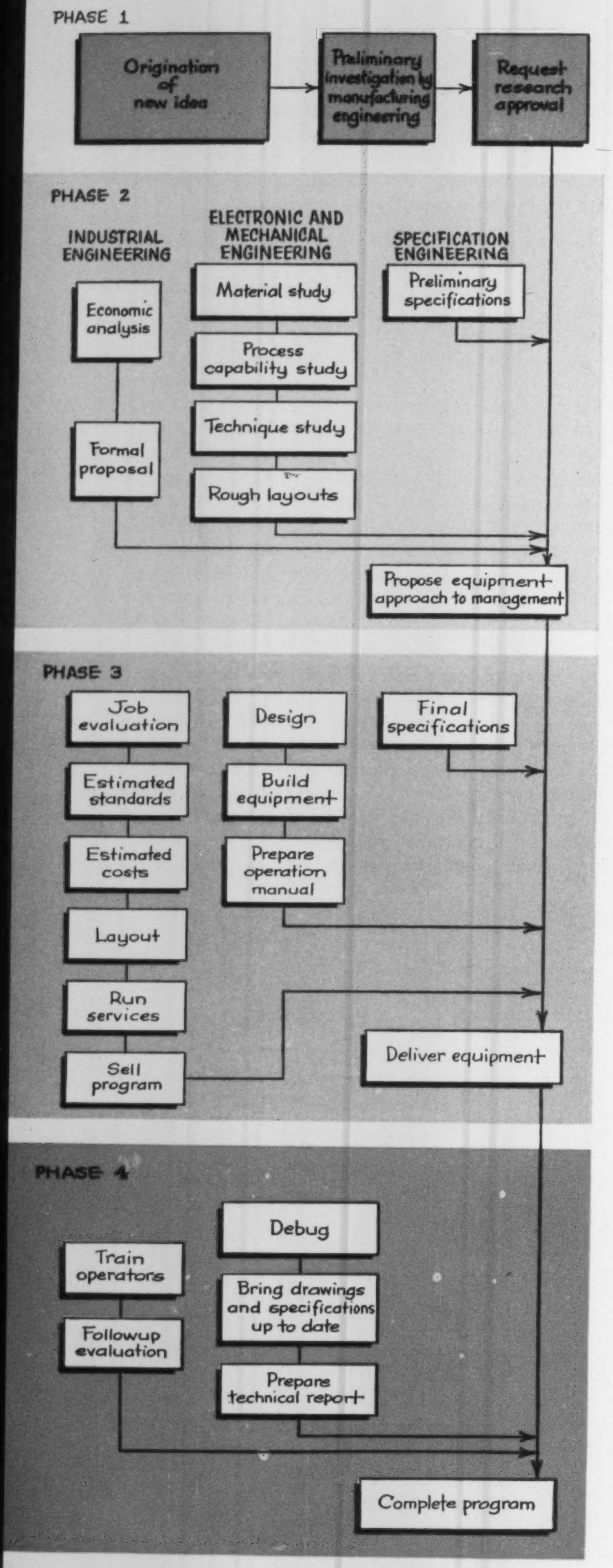


Fig. 1—Portion of company organization chart illustrates staff relationship between managers of Product Engineering and Manufacturing & Engineering. Arrangement fosters interchange of ideas on functional and manufacturability requirements for new products being designed. Close relationship between plant managers responsible for shop operations and manager of manufacturing engineering encourages co-operation between these two groups.


PHASE 1
Origination of new idea
Preliminary investigation by manufacturing engineering
Request research approval
PHASE 2
INDUSTRIAL ENGINEERING
ELECTRONIC AND MECHANICAL ENGINEERING
SPECIFICATION ENGINEERING
Economic analysis
Formal proposal
Material study
Process capability study
Technique study
Rough layouts
Preliminary specifications
Propose equipment approach to management
PHASE 3
Job evaluation
Estimated standards
Estimated costs
Layout
Run services
Sell program
Design
Build equipment
Prepare operation manual
Final specifications
Deliver equipment
PHASE 4
Train operators
Followup evaluation
Debug
Bring drawings and specifications up to date
Prepare technical report
Complete program

ty of the product being designed. Product engineering can then weigh these suggestions in terms of their effects on performance requirements, and profit from those which are acceptable. Manufacturing engineering is also responsible for providing any jigs, fixtures, or other tooling that may be required in the initial design stage. Experience gained in designing this first tooling will provide background knowledge which can assist later when full-scale production facilities are developed.

▶ Planning Methods Improvements

Planning production methods improvements is a difficult task, particularly where the product is in the development stage or where the industry is experiencing rapid growth as is the electronic industry. For this reason, scheduling of methods improvements presents a severe challenge. Nevertheless, because of customer demands for competitive delivery, quality, and costs, it is mandatory that there be a well-planned manufacturing engineering program.

The primary concern in developing a formal program is with charting all of the intended objectives. Establishing accuracy 5 years or so in the future is not vital at this stage, since the development time may be used as a buffer factor. A second objective of a formal methods improvement program is to permit measuring progress toward the established goals. Periodic reviews during the development time may be used to detect any need to alter directions.

The program should be developed around both building block and functional production concepts. As operations are added under the building block concept, a shift may be made to line production layouts should this prove desirable. A review of the entire program is necessary to ensure that equipment will be designed for optimum production balance. The equipment must also be capable of handling the material tolerances and producing a final product that meets all specifications.

In looking at the entire program, areas requiring the greatest amount of research and development work may be singled out and started well in advance of the date mechanization of the operation is required. Delays in research and development work need not completely stall the mechanization program because the building block concept permits temporary alternate measures. These measures may be put into effect during the delay period if there is economic justification.

The importance of scheduling design and development work, as well as build and delivery work, cannot be over-emphasized. Target dates must be established. The manufacturing engineer in charge of the project then has full responsibility for sound-

Fig. 2—Major methods improvement programs usually proceed in four distinct phases. Chart indicates activities and responsibilities of various manufacturing engineering groups in each phase.

ing the warning at the first moment that a target date appears unattainable. When this warning is not given early enough, confusion results in the build shop, the manufacturing activities, and the sales and advertising programs.

Four-Phase Approach

Major equipment programs usually involve four phases, *Fig.* 2. Minor equipment programs, of course, may omit one or more of the steps indicated.

Phase 1 begins with the origination of a new idea or proposal. The idea may originate from several possible sources, and is turned over to the Industrial Engineering Section of the manufacturing engineering organization for preliminary investigation and evaluation. This normally will result in a statement that if a program based on the idea is successful, certain improvements in manufacturing costs may be expected. Proposals which offer the greatest savings potential are then formally submitted to management for approval of research and development money only (at this stage, the manufacturing engineering group is in no position to estimate either equipment development time or equipment costs). Management, of course, should realize that the direction and outcome are largely unknown, and that a fruitful conclusion may not be achieved. Thus, the immediate objective is to add to present engineering information, with the expectancy that at least, say, 20 per cent of the projects considered will result in improved manufacturing methods.

With the approval of research and development funds, Phase 2 begins. The first step in the second phase is to agree to preliminary specifications for materials, processes, and quality requirements of the finished products. Too often, projects are started without having these points settled. After agreement on preliminary specifications, the next step is to study the process capability. Here, it is important to remember that the objective is to develop a production method rather than a product. In order to develop the production method, however, it is necessary to have a thorough understanding of the process variables and their relative importance to each other.

Upon completion of the study of process capabilities and methods techniques, rough layouts are made. This supplies the Industrial Engineering Section with sufficient information to make an economic analysis. Equipment cost and time for development and building are estimated by this group. The MAPI approach is suggested for evaluating equipment alternatives, since this technique seems to consider the greatest number of factors and their relationship to each other and to the over-all problem. From the economic analysis, a formal equipment proposal is prepared and submitted to management.

After management approves expenditures for design, development, and building of the final equipment, Phase 3 begins. Again, first consideration should be given to specifications for materials, processes, and quality—this time final specifications. Mechanical and electrical design can begin upon receipt of the final specifications. At this point, some consideration should be given to outside engineering assistance and/or purchases. The lead time for implementation of a new production method may often be reduced greatly by full use of outside know-how. Total elapsed time should also receive consideration. When it is decided to perform the work within the organization, the acquisition of material and building of the equipment follow completion of design and development work. The final Phase 3 activity of the Mechanical and Electrical Sections is vital to the successful performance of the equipment in the Operating Department. This is the preparation of an instruction manual for maintenance and operation of the equipment.

During the building of the equipment, industrial engineering has prepared job evaluations, production standards, and standard costs based on the manufacturing operation using the new equipment. They have also made layout preparations, installed the necessary services, and made arrangements for transportation and installation of the equipment.

The success of new manufacturing technology depends to a significant extent upon its manner of introduction at different levels of the organization. Without a satisfactory introduction, sociological problems may arise because many people are affected (either directly or indirectly) by the introduction of new manufacturing methods. As manufacturing engineering has been defined, the Industrial Engineer-

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Present responsibilities include directing and co-ordinating industrial engineering, mechanical and electronic equipment design, construction and maintenance of electronic equipment, standardizing and specifications, and facilities planning.

His professional affiliations include membership in the American Institute of Industrial Engineers and National Society of Professional Engineers.

ing Section provides the major tie-in between production personnel and the engineering organization. Industrial engineering bears the responsibility for knowing what equipment is necessary and how it will benefit production. This does not mean that other sections of manufacturing engineering are relieved of their responsibility to communicate with production people. Communication is essential during design, building, and followup. Delivery of the equipment completes the third phase of the program. Phase 3 clearly demonstrates that manufacturing engineering, in order to fulfill all of its job responsibilities, enters many fields of engineering.

The final portion of the program—Phase 4—is a followup phase which includes debugging of the equipment; training of the operators and maintenance personnel who will be responsible for the operation of the equipment; and bringing the drawings and specifications up to date.

The engineer or engineers who are in charge of the program should also be expected to prepare a technical report (or a paper, if warranted) as their conclusion to the work. The preparation of the report is a very necessary part of the program if engineers are to develop themselves fully and improve their worth to the company. It is essential that each engineer learn to convey his knowledge to others so that they may learn from his experience. A fundamental objective should be the development of the engineer to a professional level, so that management can have complete confidence when considering approval of future programs requiring engineering skills.

Another important final step in Phase 4 is that of a followup review 3 to 6 months after the installation of the equipment. The purpose of this review is to compare the actual production experience against the predictions made in the formal proposal presented in Phase 2.

Measuring Effectiveness

Contributions of a manufacturing engineering group toward over-all company objectives may be measured in several ways. One measure of performance is that of the organization's productivity gain over a period of time. With effective manufacturing engineering, the productivity trend should be rising. Good mechanization programs put into effect by this group can also improve product quality levels, although this is sometimes difficult to attribute directly to improved manufacturing methods.

Another index useful for measuring effectiveness of manufacturing engineering is obtained by comparing unit costs for periods preceding and following completion of a methods improvement program. Adjustments should be made accounting for possible differences in labor rates, material costs, etc., in the periods being compared. In most cases this index is best employed on a departmental basis with comparisons of costs of individual operations rather than total costs per unit.

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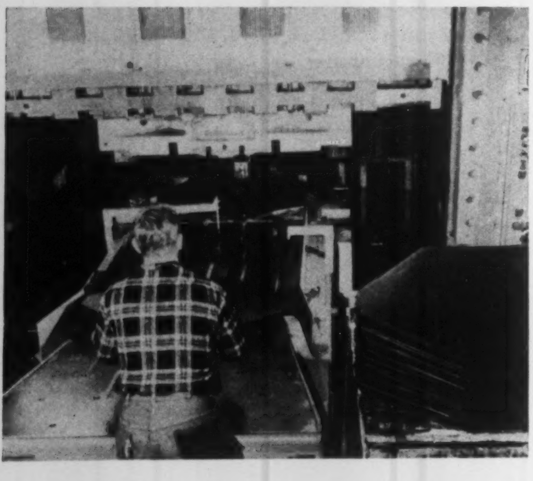
press loader has controlled torque drive

RHEOSTAT control of torque is a feature of the drive for a semiautomatic press loader at the Ford Stamping Plant in Chicago. The setup is used to load door hinge reinforcement member blanks for Mercury automobiles into a forming press.



To load the press, an operator removes steel blanks from a stack and slides them, one at a time, down an incline at the front of the press. When a blank reaches the bottom of the incline, it is in a position where it can be picked up by a series of feed fingers and advanced into the die area.

The press loader drive is actuated when the operator presses a *Start* pushbutton for a press cycle. The feed fingers then engage the blank from the rear and push it under the die against a stop on the far side of the press.

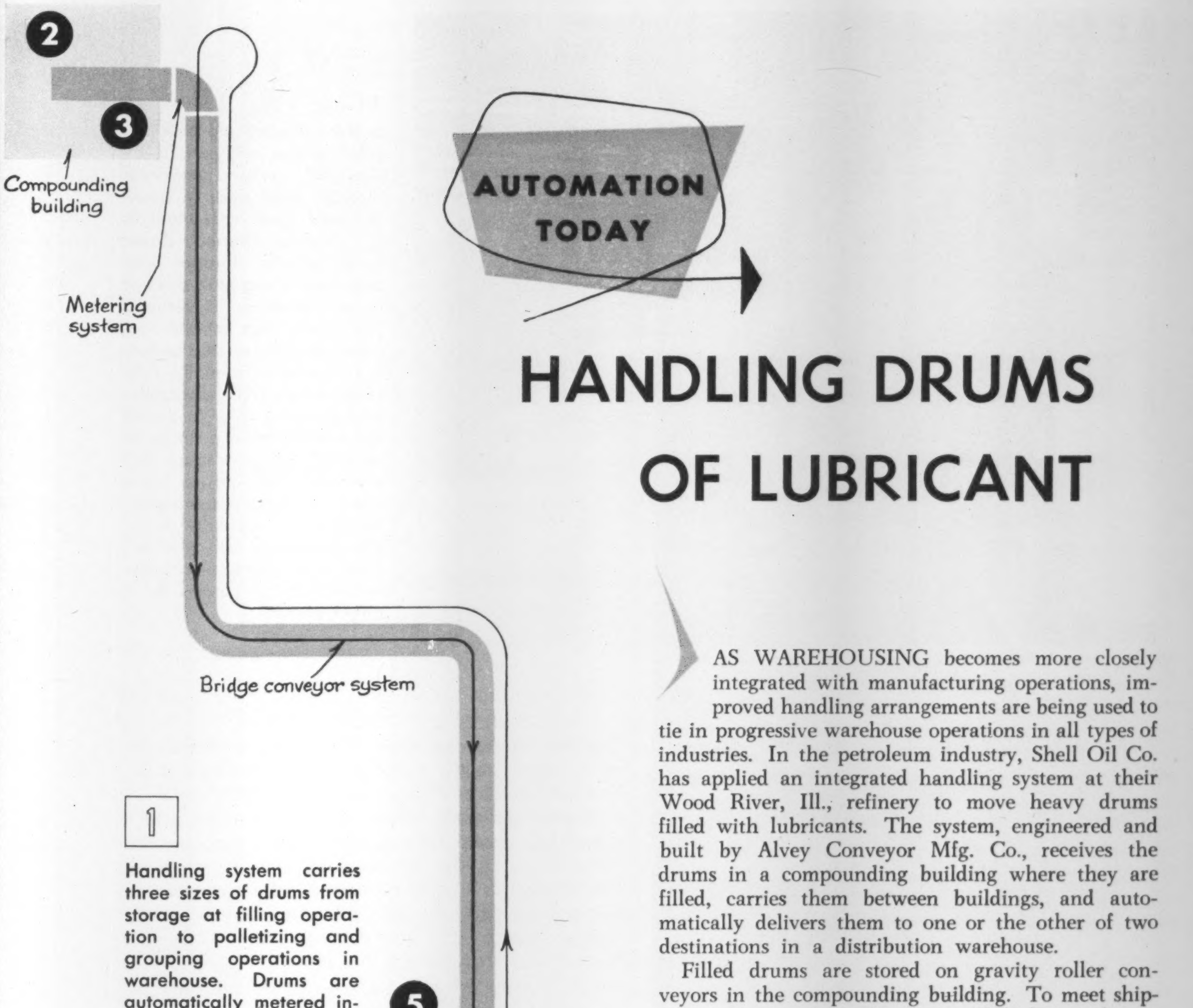
Adjustability of driving torque is required to ensure against bouncing of the blanks away from the stop at the end of the loading stroke. This can occur if too much torque is exerted by the drive in advancing the feed fingers and part. If such an action occurs, the line supervisor reduces the torque by turning the rheostat knob on the control for a Warner Electric Clutch & Brake Co. clutch-brake that engages the drive. The ability to control torque would also be useful in the event that the part design (and weight) should change.

AUTOMATION TODAY

HANDLING DRUMS OF LUBRICANT

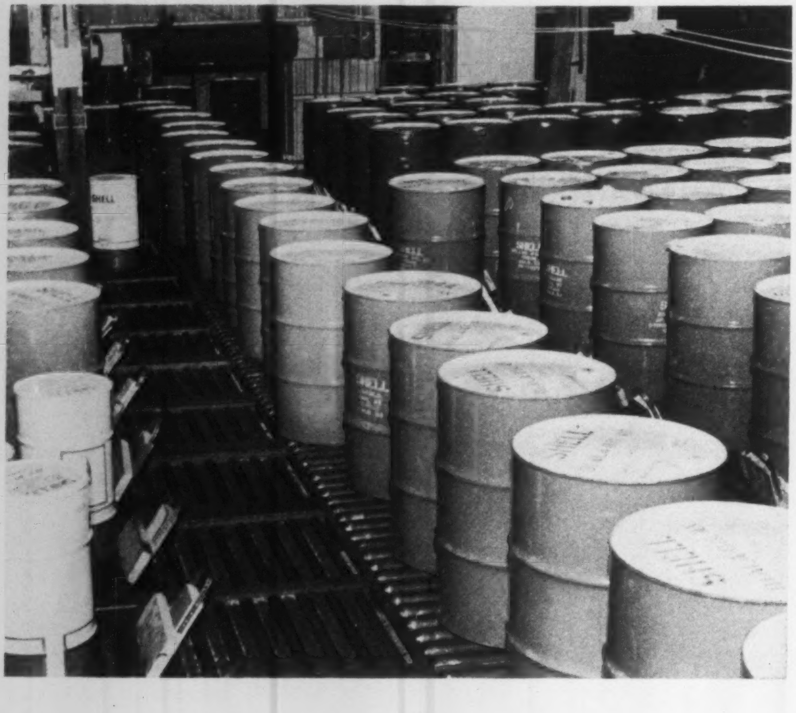
AS WAREHOUSING becomes more closely integrated with manufacturing operations, improved handling arrangements are being used to tie in progressive warehouse operations in all types of industries. In the petroleum industry, Shell Oil Co. has applied an integrated handling system at their Wood River, Ill., refinery to move heavy drums filled with lubricants. The system, engineered and built by Alvey Conveyor Mfg. Co., receives the drums in a compounding building where they are filled, carries them between buildings, and automatically delivers them to one or the other of two destinations in a distribution warehouse.

Filled drums are stored on gravity roller conveyors in the compounding building. To meet shipping orders, a dispatcher manually releases the required drums to a power conveyor system. He also places a color code marker on the first drum in each group. The drums are automatically metered from the power conveyors in the compounding building



1

Handling system carries three sizes of drums from storage at filling operation to palletizing and grouping operations in warehouse. Drums are automatically metered into conveying system between buildings. They are moved to one of two destinations in the warehouse in accordance with a color code signal.



2

In the compounding building, filled drums are carried by powered roller conveyor through small door in background. Dispatcher manually releases desired drums from gravity storage lines arranged along both sides of power conveyor. Overhead pull cords can initiate forward, reverse, or stop action, but conveyor normally runs continuously. The dispatcher also places a color target on the lead drum in a group to establish the warehouse destination. This power conveyor in the compounding building is actually composed of three conveyor sections which are electrically interlocked for control by a single switch.

onto a conveyor leading to the warehouse 1250 feet away.

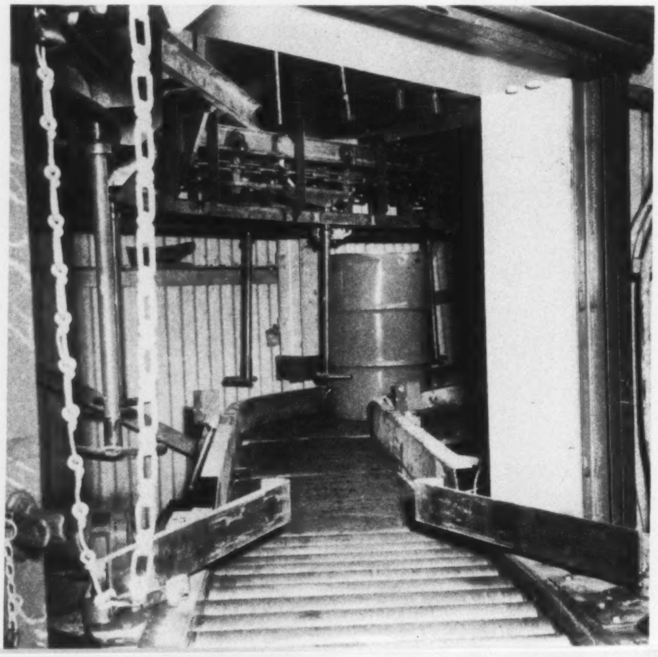
This conveyor between buildings is built in an enclosed overhead bridge which negotiates several curves and bends. The heavy drums are supported by a gravity roller conveyor and positively moved by pusher arms mounted on an overhead trolley conveyor. The arrangement metering drums into the bridge system is controlled by the overhead trolley conveyor to allow only one drum per pusher.

When the drums reach the warehouse, they move through an automatic switching arrangement. The color code marker on the lead drum in the group is sensed by a photoelectric system which causes a deflecting device to direct all drums in the group to the selected one of two destinations in the warehouse. One of these destinations is an automatic drum palletizer, the other is an automatic grouper which forms four or six drums into a pattern that can be picked up by specially equipped lift trucks. The lift trucks can place the groups of drums directly into freight cars, trucks, or storage racks. Storage capacity is approximately 14,000 drums.

Use of powered roller conveyors for the bridge conveying system was considered, but the idea was discarded with the following reasons in mind: 1. The system is basically a means of transportation, not storage. Drums are not accumulated on the bridge; about eight drums enter the system per minute and travel across the bridge at a rate of 45 fpm. 2. Powered roller conveyors would have, of necessity, been small sections joined together and

3

As the drums leave the compounding building, they are centered on the conveyor by the arms visible in the doorway. Triggered by the trolleys on the overhead pusher arrangement, two short sections of belt conveyor meter the drums into the conveying system over the bridge between buildings. The drums are supported in the bridge system by gravity rollers and moved by pushers on the overhead conveyor. Each pusher is supported by two trolleys and passes between two guides anchored to the overhead track.



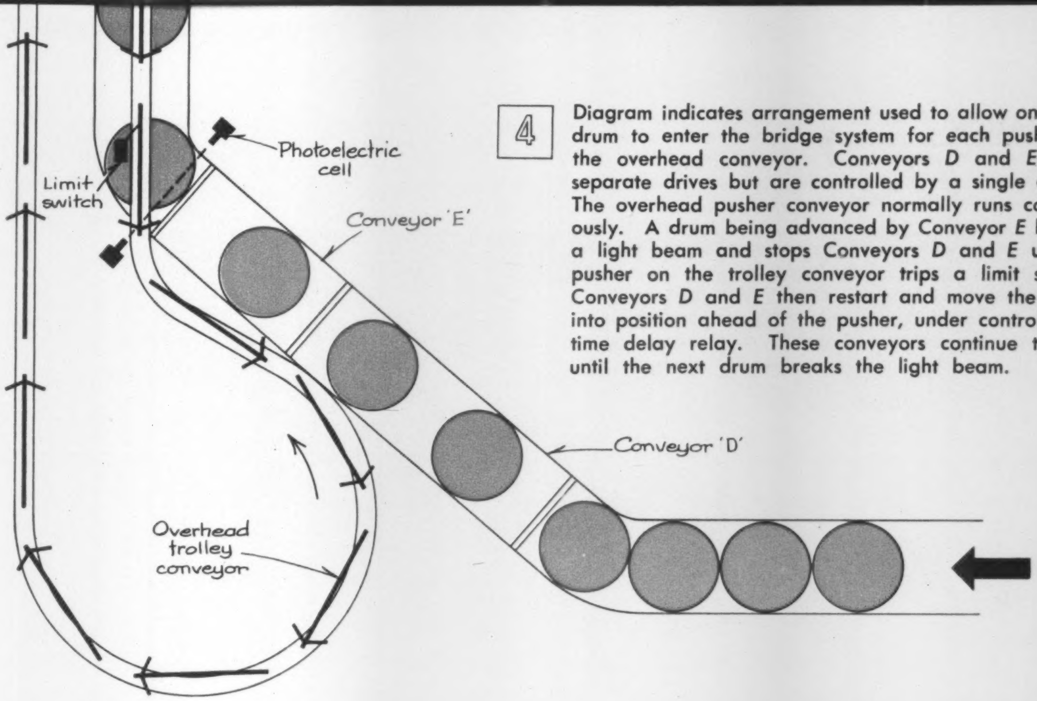


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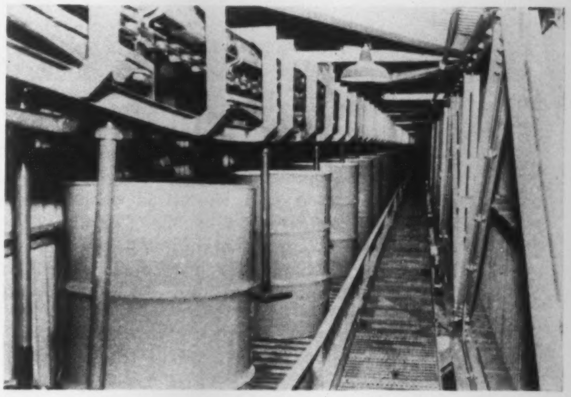
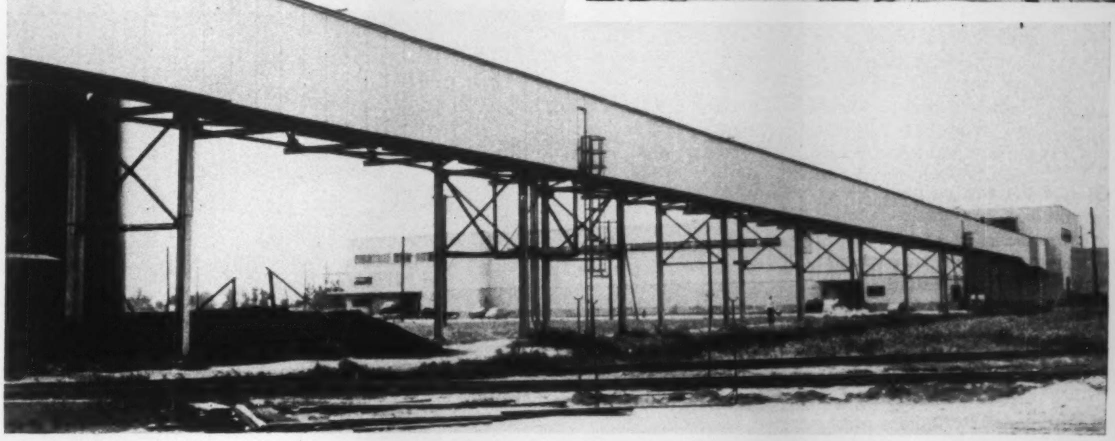
Diagram indicates arrangement used to allow only one drum to enter the bridge system for each pusher on the overhead conveyor. Conveyors *D* and *E* have separate drives but are controlled by a single circuit. The overhead pusher conveyor normally runs continuously. A drum being advanced by Conveyor *E* breaks a light beam and stops Conveyors *D* and *E* until a pusher on the trolley conveyor trips a limit switch. Conveyors *D* and *E* then restart and move the drum into position ahead of the pusher, under control of a time delay relay. These conveyors continue to run until the next drum breaks the light beam.

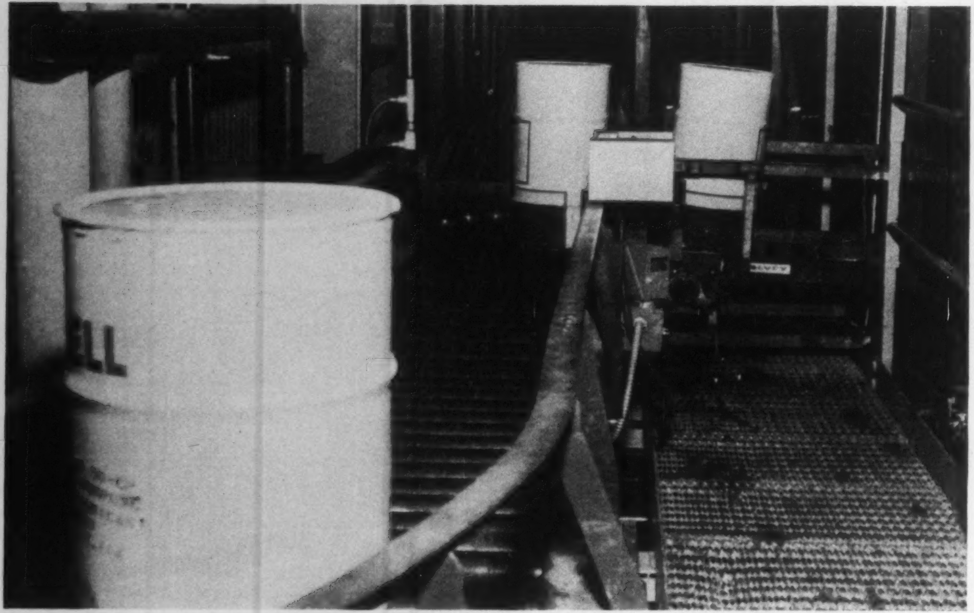
requiring many accompanying drives and controls. The overhead trolley pushers require only three drives for the entire bridge system. 3. Movements of various sizes of drums would not be controlled as well over changes of elevation. Drums handled include 55-gallon, 30-gallon, and 120-pound sizes.





5

Conveyor system in overhead bridge connects the compounding building and the warehouse 1250 feet away. The bridge conveyor system uses four drives which are controlled so that they normally run continuously unless the first conveyor in the warehouse is stopped. Each of the drives on the chain for the pushers has a special safety switch in addition to the usual starter overload devices. Each drive has a limit switch mounted on a floating frame, and if chain pull exceeds the tension of a restraining spring, the drive is stopped.

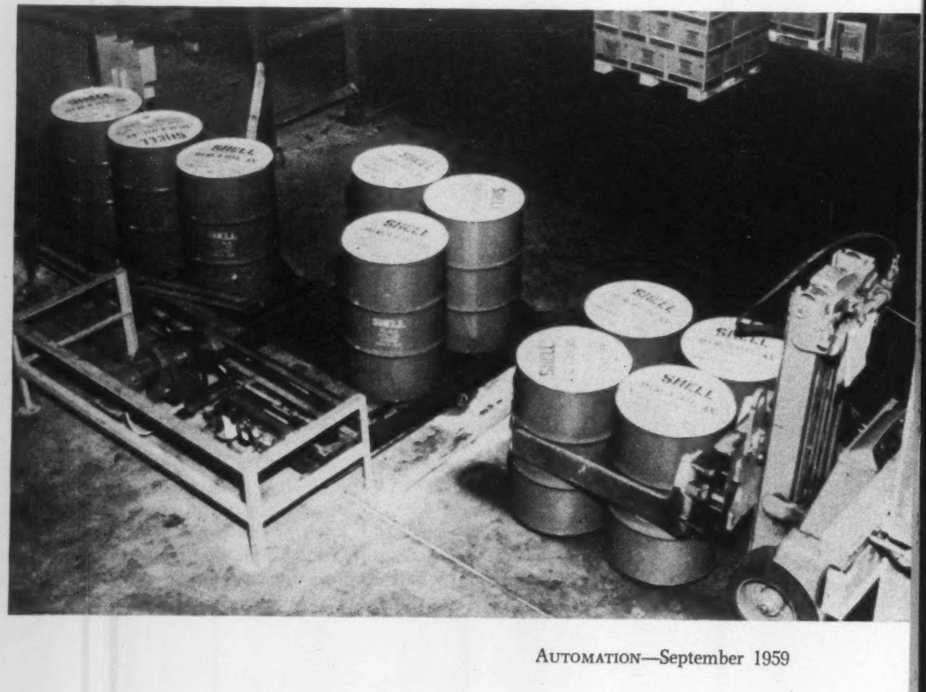


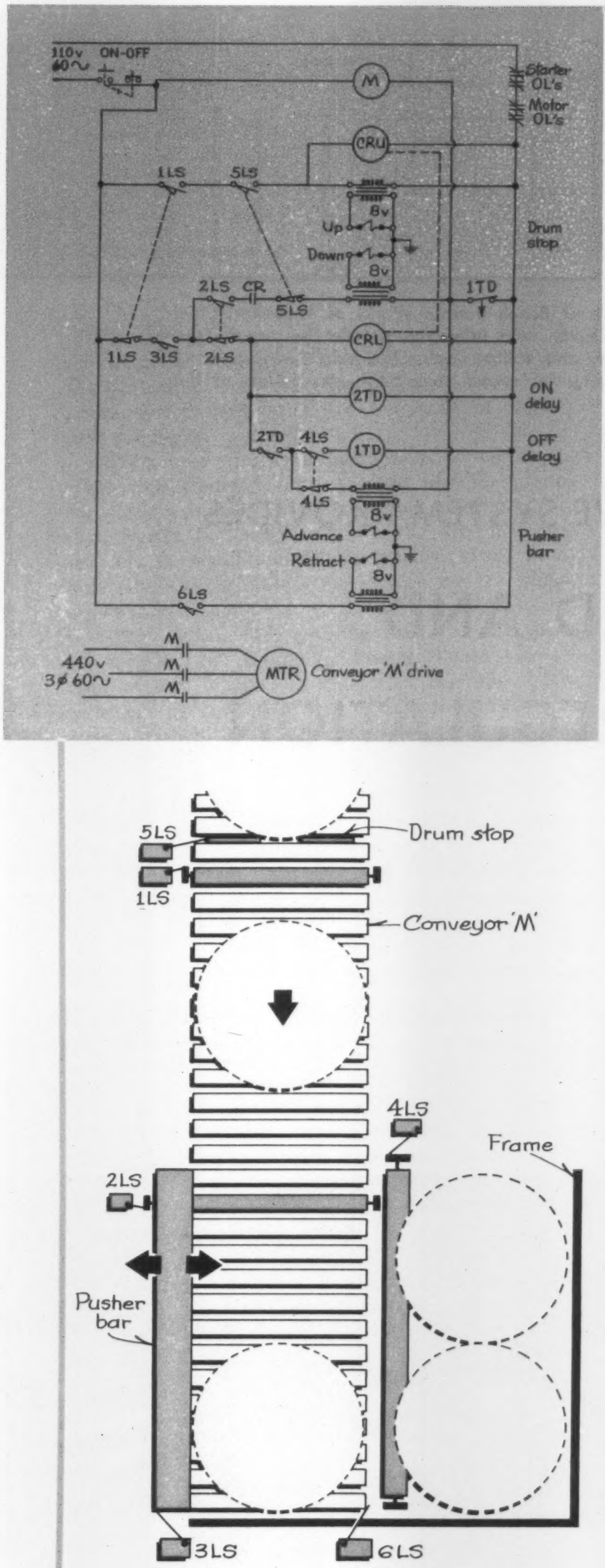
6

In the warehouse, drums are advanced by powered roller conveyor from left foreground through a diverting arrangement. Drums advance straight ahead to go to the drum grouper, or are deflected to the conveyor running to the right toward the drum palletizer. With the diverting gate in a given position, the incoming conveyor is stopped and started in conjunction with the selected outgoing conveyor. Limit switches actuated by the diverting gate determine which of the two outgoing conveyors control the incoming conveyor. The position of the deflector is changed by an air cylinder when a color target is sensed by a photoelectric system. Three additional photoelectric systems prevent the deflector from being moved while a drum is passing.

7

One of the two points in the warehouse at which drums are unloaded from the conveyor is the drum grouper in left foreground. Drums coming from the diverter move down an inclined conveyor and make a 180-degree turn to enter the drum grouper. Drums are grouped into square or rectangular patterns—four 50-gallon, four 30-gallon, or six 120 pound drums. A group of drums is picked up by a lift truck with a clamping attachment and either stored in the warehouse or placed in outgoing freight cars or trucks.




110v
60~
ON-OFF
M
Starter OL's
Motor OL's
CRU
1LS
5LS
8v
Up
Down
8v
Drum stop
2LS
CR
5LS
1TD
CRL
1LS
3LS
2LS
2TD
ON delay
2TD
4LS
1TD
OFF delay
4LS
8v
Advance
Retract
8v
Pusher bar
6LS
M
M
M
440v
3ø 60~
MTR
Conveyor 'M' drive
5LS
Drum stop
1LS
Conveyor 'M'
4LS
Frame
2LS
Pusher bar
3LS
6LS

COMPONENT	ACTUATED WHEN
1LS	Roller on conveyor is depressed
2LS	Roller on conveyor is released
3LS	Pusher bar is in retracted position
4LS	Roller on conveyor is depressed
5LS	Drum stop is down
6LS	Pusher bar is in advanced position
CR	Coil CRL is energized, but remains actuated until coil CR is energized
1TD	Coil 1TD is energized, remains actuated for preset time delay after coil 1TD is deenergized
2TD	After a preset delay following energizing of coil 2TD, released when coil 2TD is deenergized

8

Sketches show electrical control arrangement and plan view of physical layout for drum grouper. The drum stop is raised and lowered by an air cylinder. The pusher bar is advanced and returned by another cylinder. With the grouper empty and Conveyor M running, the drum stop will be down, *5LS* actuated, and a drum will be moved into the grouper. As it passes over the roller for *1LS*, that switch causes the stop to be raised. The drum advances until it stops against the frame. Depression and release of the roller for *2LS* causes the stop to be lowered again. A second drum advances; actuates *1LS*, and the stop is raised. The second drum stops against the first drum and holds roller for *2LS* depressed longer than the delay time of timer *2TD*. Linkage of *2LS* with its roller is such that the switch is released when the roller is depressed. The pusher bar is advanced; actuates *6LS*; and is retracted. Two more drums enter the grouper in the same manner as the first and second drums. Then since *4LS* is held actuated by the first two drums, the pusher bar is not advanced. With the roller for *2LS* held depressed, the drum stop stays up; Conveyor *M* is stopped; and no more drums enter the grouper until the lift truck removes the group of drums. After the roller for *2LS* is released for the time interval preset on *1TD*, a new cycle will begin by the starting of Conveyor M and lowering of the drum stop.

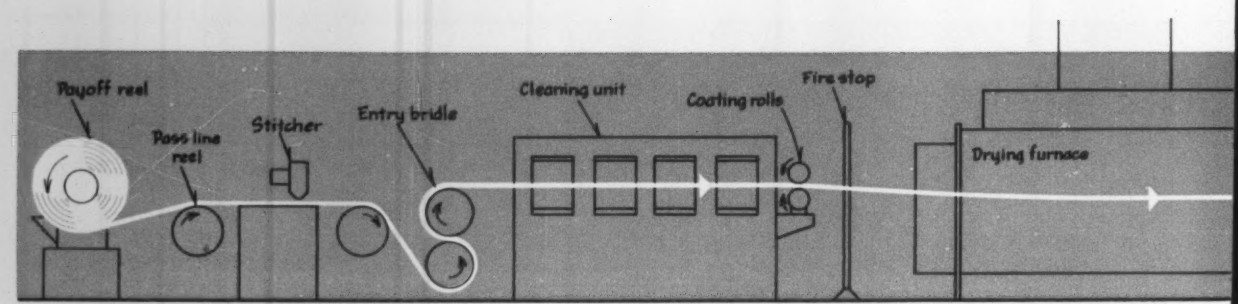


Fig. 1—Combination cleaning-coating line at Beech Bottom Works of Wheeling Steel Corp. is approximately 113 feet long. Driven units in system include the payoff reel, entry bridle, coating rolls, tension bridle, and coiling reel. The strip is unsupported over the approximately 40 feet separating the coater rolls and entry rollers of the cooling unit.

ADJUSTABLE VOLTAGE DRIVE SYSTEM PROVIDES

STRIP SPEED AND TENSION REGULATION

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Application Engineer
Square D Co.
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DESIRED strip tension in a processing line can be obtained by varying the relative torque developed by individual rotative elements in the line. Since relative torque in such systems is the criterion, regulation is achieved by changing the torque of certain elements, resulting in a greater forward pull or a greater back pull on the strip. For all practical purposes, the various drive rolls and powered payoff and coiling elements for a given line divide the over-all problem of maintaining tension into several problems—and a single system can contain both approaches to tension regulation.

Tension regulation, in such cases, can be closely interrelated to equally critical problems of limiting strip speed at some point in the line and synchro-

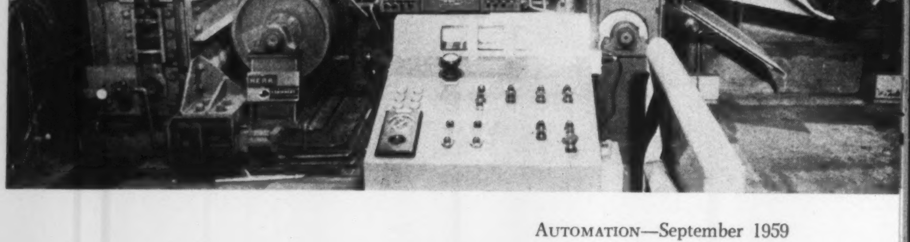
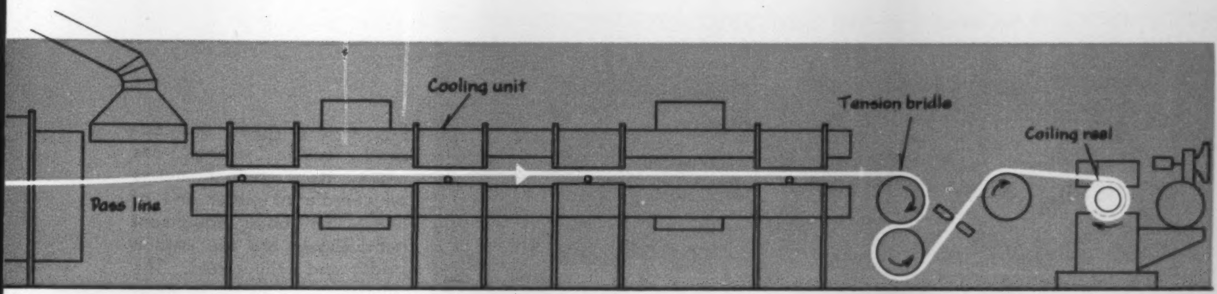


Fig. 2—Photograph of inlet end of system shows metal stitcher (behind operator's console). The line is brought to a stop to stitch end of one coil to beginning of new coil. The payoff reel was supplied by Paxson Machine Co.; the stitcher unit and entry bridle unit were obtained from Herr Equipment Co.



nizing the various drive elements in the line. As requirements vary from installation to installation, the control schemes used to solve these interrelated problems represent unique combinations of old and new principles.

An example of this uniqueness is found in the continuous coating and scrubbing line for electrical steels established by Wheeling Steel Corp. at their Beech Bottom Works, *Fig.* 1. The line consists of: A payoff reel, metal stitcher, entry bridle unit (these three units are shown in *Fig.* 2), cleaning-coating machine, furnace, cooling section, tension bridle unit, and a coiling reel. Coil transporters supplied by Automatic Transportation Co. are used to convey coils to and from the line. Coils, weighing up to 16,000 lbs, of 22-29 gage strip in widths from 16 to 36 inches are handled by this line.

▶ Line Details

Lack of space led Wheeling engineers to modify a Hanson-Van Winkle-Munning Co. scrubber, *Fig.* 3, to enable it to perform as either a cleaning or a coating machine. When operated as a scrubber, the equipment is used to remove magnesium oxide from annealed electrical coils. Wringer and brush rolls on the machine operate in normal fashion for cleaning.

From the cleaning-coating machine, strip passes through the furnace, an Electric Furnace Co. unit. Specifications permit a maximum furnace temperature of 1600 F and a maximum strip temperature of 1500 F. The strip takes a catenary shape within the furnace, being suspended between the coater rolls at the inlet side and the first of several simple support rollers in the cooling section at the outlet side of the furnace. The tension bridle is located at the outlet end of the cooling hoods, followed by the coiling reel, *Fig.* 4.

In addition to changeover because of coating and cleaning specifications, the scheme of operation provides that the line be stopped to stitch the trailing end of strip from one coil to the beginning end of a new coil. The line is then restarted and stopped once again when the stitched portion of the strip reaches the coiling reel. The full coil along with the stitched section is removed from the coiling reel mandrel, and operations are then resumed.

The payoff reel at the entry end of the line is driven by an ac motor and equipped with a drag brake. This unit is not part of the adjustable voltage drive system provided for the line. Units within the system include: A 15 hp dc motor for the entry bridle, 3 hp dc motor for coater rolls, two 10 hp dc motors for the tension bridle, and a 25 hp dc motor for the coiling reel. All of these motors, with the exception of the coater roll drive, are provided with shunt brakes. A 17 kw motor-generator set, *Fig.* 5, supplies adjustable voltage to these dc motors. The system includes an additional power source in the form of two booster generators driven by a single ac motor. One booster, a 1.5 kw unit, is associated with the entry bridle and coater roll drives. The second booster, a 3 kw unit, is associated with the coiling reel drive. All of the voltage supplies are started and stopped simultaneously. The complete adjustable voltage drive system, including rotating equipment, was furnished by the Square D Co. The motors and motor-generator sets were manufactured by the Allis-Chalmers Mfg. Co.

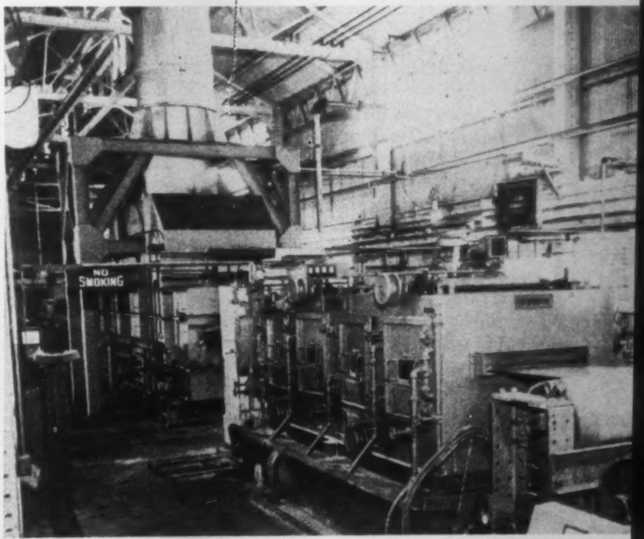


Fig. 3—Cleaning machine furnished by Hanson-Van Winkle-Munning Co. was modified by powering the wringer rolls at the machine's outlet. With coater rolls substituted in place of the wringer rolls, the line can be used to apply various coating materials to the strip.

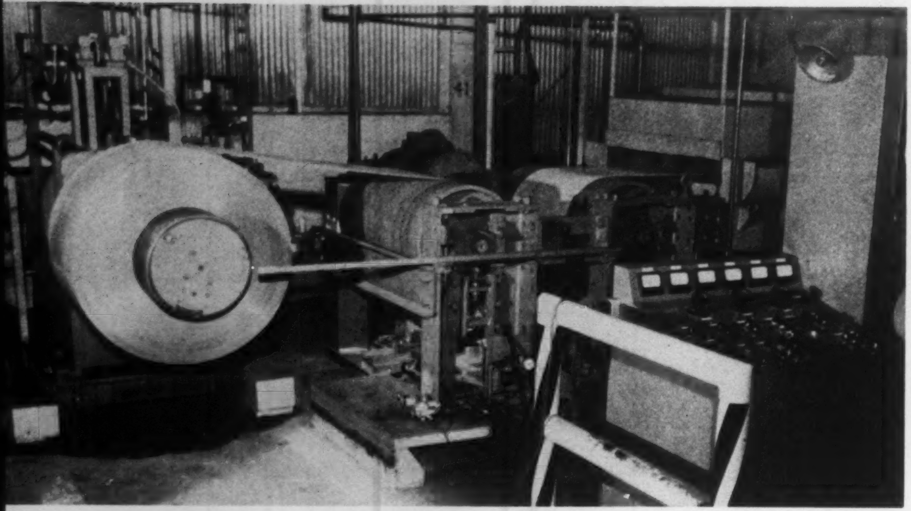


Fig. 4—Line speed and desired tension settings are made from potentiometers on console at outlet end of line. The major equipment items shown are the tension bridle and coiling reel. The operator is guided in making speed settings by a speed indicating dial that obtains its signal from a tachometer generator coupled to the tension bridle.

Over-all line speed of the system, adjustable over the range of 30 to 250 fpm, is controlled from a potentiometer located on a console at the delivery end of the line. A change in the setting of this potentiometer is sensed by a follower in a motor operated potentiometer circuit. The motor operated potentiometer in turn supplies the appropriate speed signal to a magnetic amplifier exciter in the main generator shunt field. Automatic speed regulation is obtained by comparing the desired speed signal with a signal derived from a generator voltage feedback circuit.

The purpose of varying strip speed is to obtain different processing speeds and for this reason speed is measured at the tension bridle—the effective outlet of the processing system. A tachometer generator is coupled to one of the bridle rolls and the speed read on an indicator at the control console guides the operator in making speed changes.

▶ Tension Regulation

With the type of operations as outlined, maintaining proper tension during stalled conditions and during those times when the entire line is jogged forward or reverse can be as important as maintaining tension during running.

Separate tension regulators and their respective reference circuits are provided for the entry bridle motor and the coiling reel motor. The desired tensions are set on potentiometers mounted on the console located at the delivery end of the line. These signals are sensed by reference windings in saturable reactors. The feedback windings in the saturable reactors are connected across resistors in the motor armature circuits. The differential ampere turns between the reference and feedback windings provide the appropriate voltage changes in the motor shunt fields by means of reactor output wind-

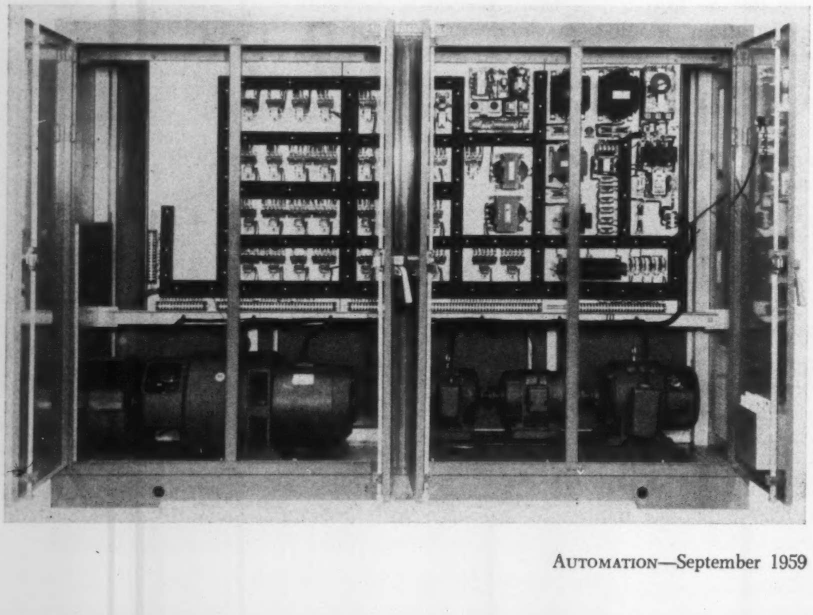
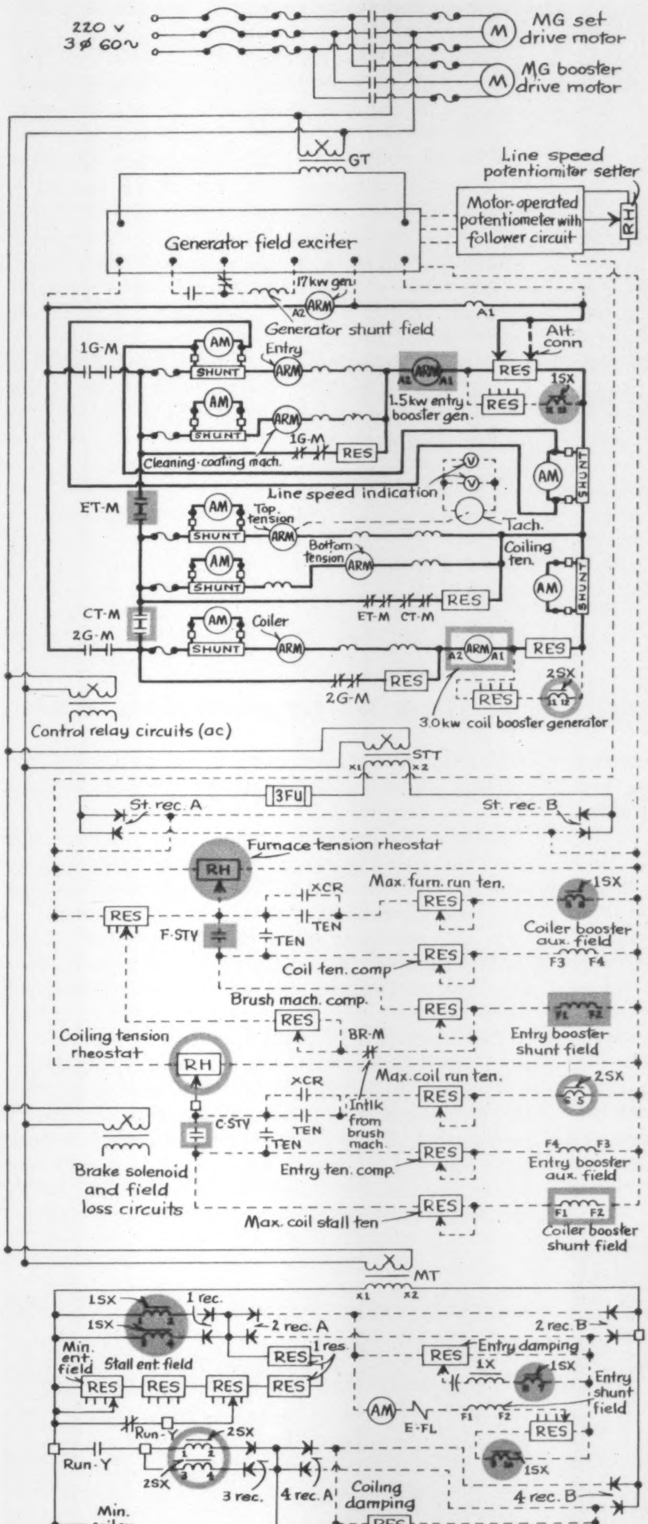


Fig. 5—Main drive controller contains: Motor-generator set, two booster generators, and various control circuits including a magnetic amplifier exciter for the generator shunt field and two tension regulator circuits. The starter and relay section of the controller is shown.


220 v
3 ø 60~
MG set drive motor
MG booster drive motor
GT
Line speed potentiomiter setter
Motor-operated potentiometer with follower circuit
RH
Generator field exciter
17kw gen.
ARM
A2
A1
Generator shunt field
Alt. conn
1G-M
AM
SHUNT
Entry
RES
1SX
1.5kw entry booster gen.
Cleaning-coating mach.
V
Line speed indication
Tach.
ET-M
Top tension
Bottom tension
Coiling ten.
ET-M CT-M
CT-M
2G-M
Coiler
2SX
3.0kw coil booster generator
Control relay circuits (ac)
STT
X1
X2
3FU
St. rec. A
St. rec. B
Furnace tension rheostat
Max. furn. run ten.
XCR
TEN
F-STY
Coiler booster aux. field
F3
F4
Coil ten. comp
Brush mach. comp.
Entry booster shunt field
BR-M
Coiling tension rheostat
Max. coil run ten.
C-STY
Intlk from brush mach.
Entry booster aux. field
Brake solenoid and field loss circuits
Entry ten. comp.
Max. coil stall ten
Coiler booster shunt field
F1
F2
MT
1 rec.
2 rec. A
2 rec. B
1 res.
Entry damping
1X
Min. ent. field
Stall ent. field
Entry shunt field
E-FL
Run-Y
3 rec.
4 rec. A
4 rec. B
Coiling damping
Min. coiler field
2X
2C
Ten taper
Coiler shunt field
C-FL

Speed and Tension Control Circuits

Connection and elementary diagram indicates three of the circuits involved in tension regulation. Elements involved in run tension regulation are pointed out on the diagram by circular color forms. Using the coiling reel circuits containing saturable reactor 2 *SX* as an example, the current in reference winding (5-6) in the coiling tension rheostat circuit reflects the desired tension. The feedback winding (11-12) is energized by the voltage drop across a resistor in series with the motor armature. The voltage drop across the resistor is a measure of motor armature current, and hence, torque. Changes in strip tension will affect torque and the current in the feedback winding. The differential ampere turns between the reference and feedback windings results in a net excitation that determines the voltage level at the reactor's output windings (1-2, 3-4). This output voltage is rectified to control the coiler motor speed through its shunt field. Furthermore, during running conditions the booster generators supply enough power to compensate for the armature voltage drop of the motors.

The rectangular color forms on the diagrams point out the booster generator shunt field and armature circuit elements involved in obtaining tension during stalled conditions. Until a *Line Run* pushbutton is actuated, normally open contacts *1G-M* and *2G-M* in the loop circuit isolate the 17 kw generator from the several drive motors. The circuits for the booster generators have been completed by closing of normally open contacts *ET-M* and *CT-M*. The fields for the generators are energized by closing of contacts *F-STY* and *C-STY*. The booster generators then supply voltage to drive the entry bridle and coiler reel motors, from which the shunt brakes have been released. These motors are so driven as to pull the strip in both directions away from the tension bridle rolls, from which the shunt brakes have not been released. The various contact actions and the release of the shunt brakes for the operations described follow the actuation of *Furnace Stall Tension* and *Coiler Stall Tension* pushbuttons in the ac relay control circuit.

KEY

Power ————————
AC control ————————
DC control - - - - - - - - - - - -

ings connected to the shunt fields.

The ac relay control circuits provide that *Stall Tension* pushbuttons for both furnace and coiling ends of the line be actuated before the line can be jogged as a unit or run. Under operating conditions, the two stall tension relays, energized by the pushbuttons, are de-energized only when it is desired to jog individual elements within the line. In a starting operation, energizing the stall tension relays results in: 1. Energizing the booster generator shunt fields, which are connected in the two tension regulating circuits. 2. Releasing the shunt brakes on the entry bridle and coiling reel motors. 3. Closing of contacts in the armature loop circuit to bring the two booster generators into operation. At this time the 17 kw generator is not connected in the loop circuit nor is the tension bridle motor shunt brake released.

The 1.5 kw booster generator is so connected as to supply power to the entry bridle and coater roll motors in a reverse direction, obtaining tension by pulling strip back from the locked tension bridle. The 3 kw booster generator is so connected as to supply power to the coiling reel motor in its forward direction, obtaining tension by pulling the strip forward from the locked tension bridle.

When, subsequently, either the *Line Run* or *Line Jog* pushbutton is actuated, the 17 kw generator is connected in the loop circuit and the tension bridle brake is released. All of the motors respond to the polarity of voltage output of the large generator and, for run conditions, the line accelerates at a timed rate to the speed set on the speed potentiometer.

Actuating the *Line Stop* pushbutton takes the 17 kw generator out of the loop circuit and the generator is brought to a stop by dynamic braking. After a time delay, the shunt brakes are applied to the entry bridle, tension bridle, and coiling reel motors. Following a further time delay, the shunt brakes on the entry bridle and tension bridle motors are released. The booster generators, still connected in the loop circuit, drive their associated motor to obtain proper stall tension in the strip on both sides of the locked tension bridle. The circuit relationships of some of the elements in the tension regulating scheme are indicated in the diagrams accompanying this article.

centralized recording of production data

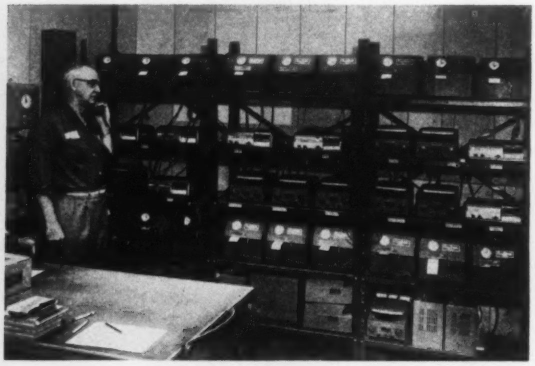
NOVEL industrial application of office recording equipment has allowed Commercial Shearing and Stamping Co. to establish an efficient centralized timekeeping group. In the system, individual recorders mounted on racks in the timekeepers' office are connected to telephone-type call-in stations located at various convenient points on the shop floor

When a plant employee lifts a handset to make a report, relay circuits activate a recorder in the timekeepers' office. The employee reports such information as clock number, order number, part number, operation description, machine number, production rate, and the identification of his previous job and pieces produced. As soon as the handset is replaced, the recorder stops. To accurately mark the time of the recorded messages, each message recorder is also connected to a separate time recorder. When the message recorder is activated, the time recorder automatically prints the time on a paper tape.

Switches at the call-in station allow the employee to signal a timekeeper for unrecorded voice conversation when the need arises. The timekeeper can also monitor calls as they are being recorded.

At the beginning of each shift, the used record, containing up to 20 reports, and its associated time-tape are removed for transcribing to a permanent form, and new records are placed on the recorders. A 24-hour report of plant operation is available to the Payroll Dept. by 10 a.m. of the following day.

The system permits the use of a minimum number of timekeepers. It overcomes the typical knotty problems of a shop on incentive work where a peak timekeeping load occurs at the end of a shift and where the operation of some shifts does not justify the presence of a timekeeper.



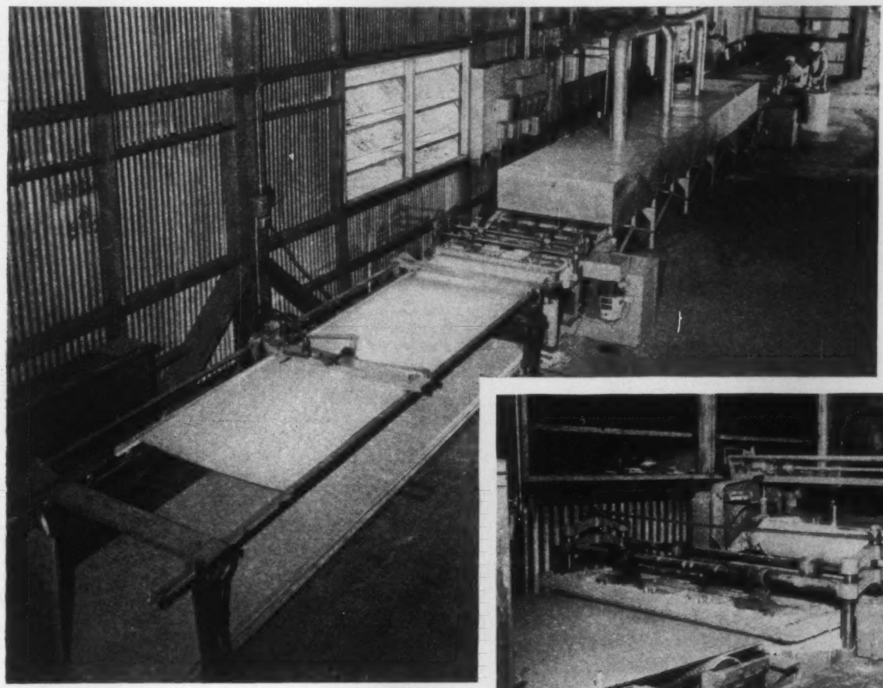


Fig. 1 — Processing line dusts, preheats, seals, dries, and buffs exterior surfaces of 4 by 16-foot hardboard panels. Panels are manually loaded at input end of line, right, and automatically stacked at exit end of line, left.

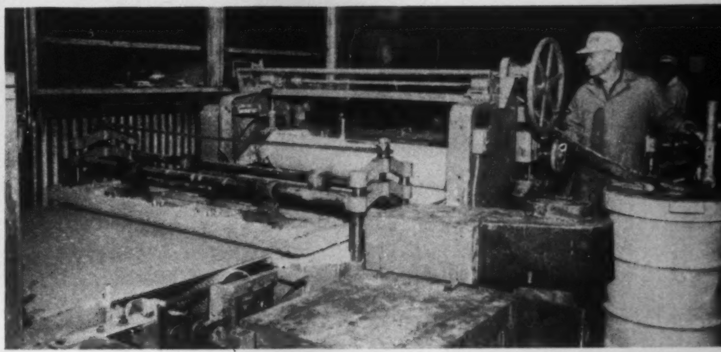


Fig. 2—Close-up shows spreader that applies uniform coating of sealer on top surfaces of panels and carpet-covered buffing head that reciprocates to rub wet sealer into small openings in panel surfaces.

FINISHING HARDBOARD PANELS ON AN INTEGRATED LINE

AT ONE STAGE in their manufacture, hardboard panels come from previous operations in rectangular form, but with minute openings in their exterior surfaces. Before the panels can be marketed, these openings must be filled by coating the surfaces with prepared sealer. The coated surfaces are then finished by curing and buffing. The coating, curing, and buffing operations are performed in an integrated, semiautomatic line, *Fig.* 1, at Allwood Div., Oregon Lumber Co. Auxiliary operations performed on the line include dusting and preheating the exterior surfaces of the panels preparatory to applying the sealer, and automatically stacking the finished panels at the exit end of the line.

Stacks of panels to be treated are delivered by lift truck and deposited on a pair of scissor lifts at the input end of the line. Two lifts are required to properly support the 4 by 16-foot panels along their lengths. The lifts are adjustable individually for height so that the top panel in a stack may be introduced manually to a set of pickup rolls that advances each sheet into the setup.

As a panel enters the line, its upper surface is dusted by a rotating nylon brush that extends across the width of the panel. The panel is then passed under a bank of infrared heating lamps to preheat the dusted surface. In the next step, the panel is carried on powered rollers through a Black Bros. Corp. spreader, *Fig.* 2. Here, a controlled-thickness coating of sealer material is applied to the top surface of the panel by neoprene-coated application rolls. A single handwheel provides screwdown adjustment of both ends of the application rolls to control coating thickness. A dial gage on the spreader permits checking of this adjustment. Either of two types of sealer—an alkyd resin or a mixture of diatomaceous earth and linseed oil—may be applied by the spreader.

All of the feed rolls at the infeed side of the spreader are driven in synchronism from a power takeoff shaft on the spreader. Panel feeding is at a rate of 40 feet per minute. Sealer is supplied to the spreader from a drum. An air operated pump, whose speed is controlled by a valve, removes the sealer from the drum and pumps it at the required rate to the reservoir of the spreader. An air compressor supplies air to operate the pump.

After a coated panel leaves the spreader, it passes through a buffer. The latter unit employs a buffing head, lined with carpeting, which bears against and reciprocates along the top surface of the panel. The function of the buffer is to rub the still-wet sealer into the surface of the panel. A single screwdown adjustment permits varying the bearing pressure of the buffing head against the panel.

Following the buffing operation, panels travel through a drying tunnel for curing of the sealer. Overhead infrared heat lamps in the drying tunnel raise the temperature of the top surfaces of the panels to about 250 F to effect curing. Speed of the line and length of the tunnel are such that a given point on a panel is in the curing tunnel for almost 1 minute.

A second buffing operation is applied to the panels when they leave the drying tunnel. The equipment, *Fig.* 3, is similar to that used for wet opera- However, the panels are dry for the second operation, and their top surfaces take on a glossy, burnished finish. Both of the buffers, and a chain conveyor that advances the panels through the drying tunnel, are driven from a common power source.

An automatic stacker, built by Oregon Lumber Co. personnel, is installed at the end of the processing line. Panels leaving the second buffer are passed between parallel arms of the stacker. The arms, of angle iron, carry skate wheel rollers that support and permit ready movement of the panels. When the leading edge of each panel reaches the end of the stacker, it actuates a limit switch. This causes a valve to open and admit air to a cylinder. The cylinder and an associated linkage then spread the stacker arms apart. When this occurs, the panel is dropped onto a platform where a stack is formed. The same lift truck that delivers stacks of panels to the line picks up the stacks of processed panels from the end of the line and carries them to the next operation.

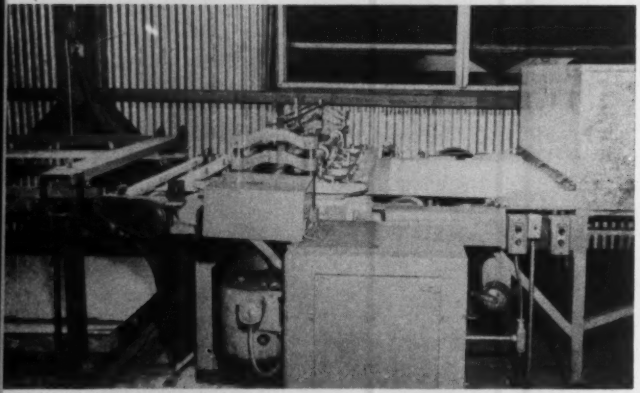


Fig. 3—View of exit end of line shows relationship of drying oven, right, dry polishing buffer, center, and automatic stacker, left.

WEIGHING SYSTEM PACES COAL FLOW

INCOMING supplies of coal are conveyed at controlled rates to predetermined destinations at the Frank H. Tait power station of Dayton Power & Light Co. Control of flow rates is effected by an electronic weighing system designed and built by Trans-Weigh Co. A similar weighing system has previously been described in detail (see —AUTOMATION, Dec. 1958).

Coal brought to the plant by railway cars is dumped into a storage bin at a car dumping station, *Fig.* 1. It is then distributed by the conveyor system. Three destinations and maximum flow rates are possible: 1. Yard storage (400 tons per hour). 2. Old bunker storage (300 tons per hour). 3. New bunker storage (800 tons per hour).

In operation of the system, an operator at a central control cubicle in the power house sets the control index on a recorder-controller to call for a desired coal feed rate. He then starts the conveyors and coal crusher equipment in sequence so that coal will be routed to the proper terminal point.

A signal from the recorder-controller positions an electrical proportioning control motor, *Fig.* 2, that mechanically adjusts the speed control lever of a variable speed drive. The drive operates a master belt feeder that removes coal from the storage bin and discharges it onto a conveyor.

A follower belt feeder below the storage bin also operates to feed coal at a rate determined by the position of an electrical proportional control motor. This motor receives signals from the control unit that are proportional to the speed of the master feeder. Thus, feed rates of both master and follower feeders are proportional. Usually a 1:1 ratio of feeder speeds is used, but this may be varied.

Sensing of actual conveyor feed rates is accomplished by means of a weighing system associated with the conveyor that lifts coal to the crusher house. The weighing system employs a strain gage type load cell to sense belt loading and a tachometer that provides belt speed signals. A combination signal—representative of weight and time—is compared in the recorder-controller with the setting on the control index. The resultant error signal is then

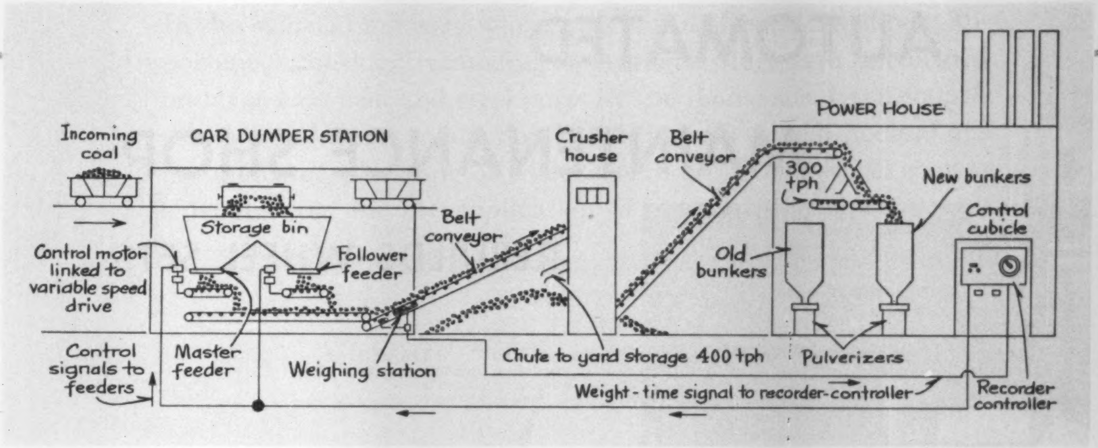

Incoming coal
CAR DUMPER STATION
Storage bin
Control motor linked to variable speed drive
Follower feeder
Belt conveyor
Crusher house
Belt conveyor
POWER HOUSE
300 tph
New bunkers
Control cubicle
Old bunkers
Control signals to feeders
Master feeder
Weighing station
Chute to yard storage 400 tph
Pulverizers
Weight-time signal to recorder-controller
Recorder controller

Fig. 1—Schematic diagram illustrates flow paths for coal removed from storage bin in car dumper station. Weighing station senses rate of flow of coal on inclined conveyor leading to crusher house. This rate is compared with desired rate preset on controller-recorder in power house. Resultant signal is generated that controls speed of master and follower feeders to maintain desired rate.

used to either speed up or slow down the master and follower feeders automatically to maintain the desired coal feed rate from the storage bin. Control action is proportional-plus-reset type, which is adjusted at the time of startup to provide minimum overshoot and maximum control response. Total tonnage delivered during an operation is indicated on a dial on the recorder-controller.

Various control actions can be initiated by a control circuit such as the one used in this application. In addition to speed control of feeders, for example, the controller can be arranged to operate signals or alarms and start or stop operations when preset quantities of material have been delivered. Operation of the system can be automatically as well as manually programmed.

Several safety interlock provisions are incorporated in the control circuit. During startup of the system, for example, a time delay feature holds the coal feed rate to a low value for a predetermined time. This delay allows the coal from the supply bin to reach the weighing point on the belt before automatic control takes place. Otherwise, system overloading could occur.

In the event the coal supply to either or both feeders is interrupted, automatic control action is suspended and the feeders are held to their last existing speeds. When coal again becomes available to both feeders, a time delay action prevents the controller from making a change in feed rate for a period long enough for coal to reach the weighing point.

Operating errors are signaled or prevented by alarms and interlocks actuated by the control index on the recording instrument. Automatic-to-manual switchover is provided to enable individual, manual control of feed rate for each feeder in the event of malfunctioning of the automatic controls. Switching between automatic and manual operation does not introduce control disturbances.

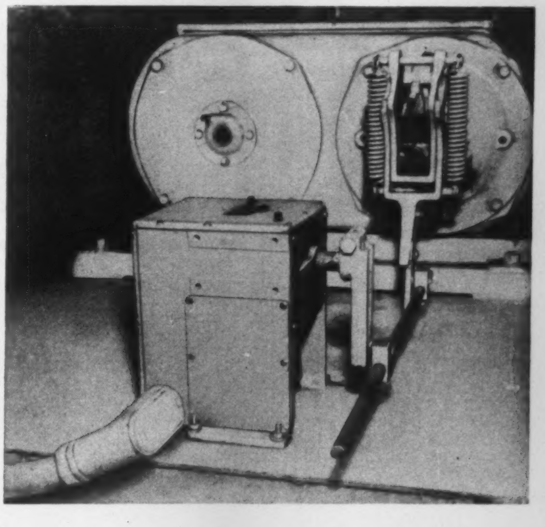
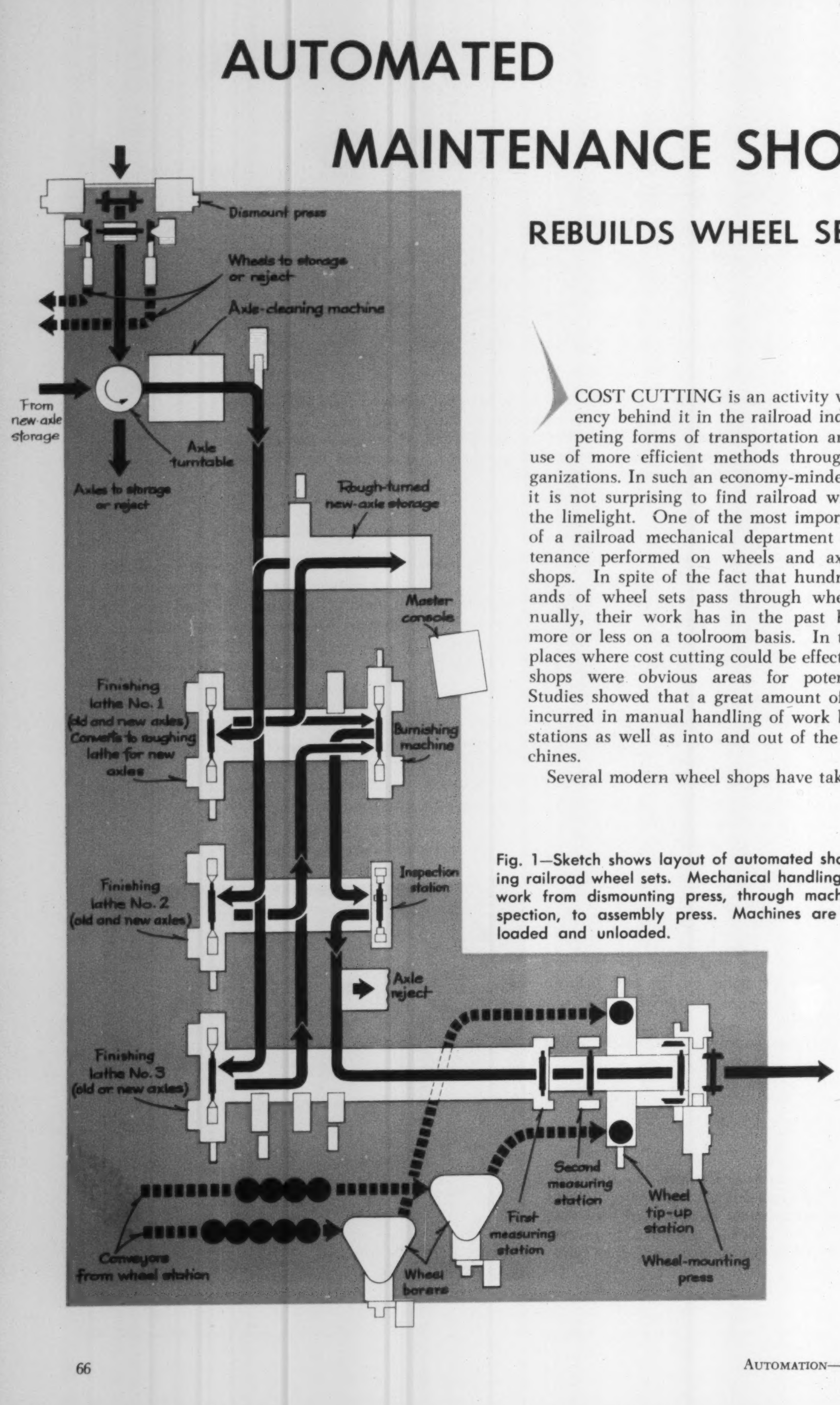


Fig. 2—An electrical proportioning control motor of the type shown in the foreground is used to control speed of each of the two feeders that remove coal from the supply bin. Each motor is linked mechanically to the speed-control lever of a variable speed drive unit for a feeder.

AUTOMATED MAINTENANCE SHOP

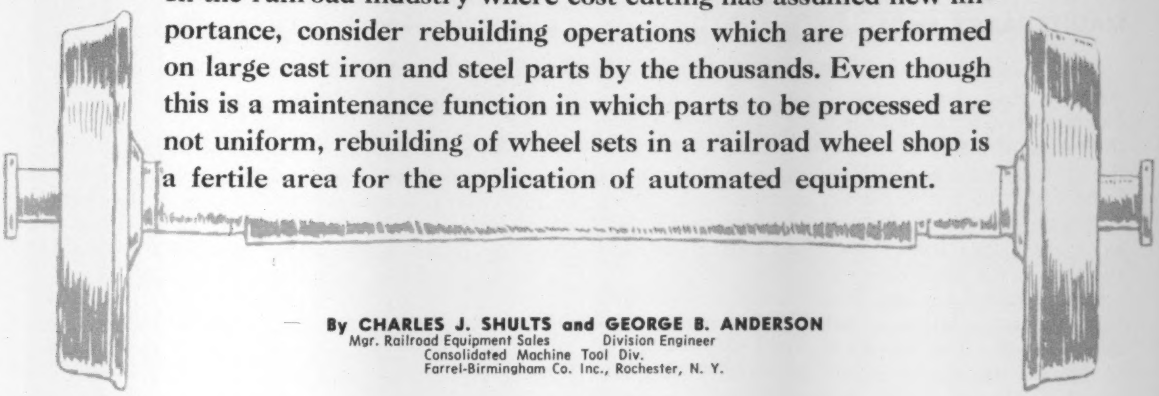
REBUILDS WHEEL SETS


Dismount press
Wheels to storage or reject
Axle-cleaning machine
From new-axle storage
Axle turntable
Axles to storage or reject
Rough-turned new-axle storage
Master console
Finishing lathe No. 1 (old and new axles) Converts to roughing lathe for new axles
Burnishing machine
Finishing lathe No. 2 (old and new axles)
Inspection station
Axle reject
Finishing lathe No. 3 (old or new axles)
Second measuring station
Wheel tip-up station
First measuring station
Wheel-mounting press
Conveyors from wheel station
Wheel borers

COST CUTTING is an activity with new urgency behind it in the railroad industry. Competing forms of transportation are forcing the use of more efficient methods throughout rail organizations. In such an economy-minded atmosphere it is not surprising to find railroad wheel shops in the limelight. One of the most important activities of a railroad mechanical department is the maintenance performed on wheels and axles in wheel shops. In spite of the fact that hundreds of thousands of wheel sets pass through wheel shops annually, their work has in the past been handled more or less on a toolroom basis. In the search for places where cost cutting could be effected, the wheel shops were obvious areas for potential savings. Studies showed that a great amount of expense was incurred in manual handling of work between work stations as well as into and out of the required machines.

Several modern wheel shops have taken advantage

Fig. 1—Sketch shows layout of automated shop for rebuilding railroad wheel sets. Mechanical handling devices move work from dismounting press, through machining and inspection, to assembly press. Machines are automatically loaded and unloaded.



In the railroad industry where cost cutting has assumed new importance, consider rebuilding operations which are performed on large cast iron and steel parts by the thousands. Even though this is a maintenance function in which parts to be processed are not uniform, rebuilding of wheel sets in a railroad wheel shop is a fertile area for the application of automated equipment.

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Farrel-Birmingham Co. Inc., Rochester, N. Y.

of possibilities to apply conveyor systems to move wheels and axles from work station to work station. Now, the Consolidated Machine Tool Div., Farrel-Birmingham Co. Inc., has integrated such a conveyor system with automatically loaded and unloaded machines, *Fig.* 1. Work is moved mechanically through the entire automated wheel shop from dismounting press to mounting press.

The entire system, with the exception of the dismount press and inspection stations is normally controlled from a single master control panel, *Fig.* 2, which is elevated to give the operator a clear view of all units. Individual control stations are also provided for each machine and conveyor to facilitate maintenance and tool changing. Tool servicing in the entire shop can be performed by one man.

This automated wheel shop is designed to disassemble, machine, and assemble 33 or 36-inch bronze-bearing freight car wheel sets. Production rate at 100 per cent efficiency is approximately 120 sets per 8-hour day. This system can produce wheel sets at a rate of one-third manhour per set. This compares very favorably with experience, for instance, of a representative Eastern railroad whose wheel shop facilities, while not automated, are better than average. It is estimated that an average of 3½ manhours are required to machine and assemble each wheel set in that shop.

Reworking Used Wheel Sets

Initial operation performed in the wheel shop is the dismounting of wheels from axles in a 600-ton Watson-Stillman press, *Fig.* 3. Reusable wheels are directed to wheel storage areas, and reusable axles are moved to a cleaning machine or intermediate storage. Scrap wheels and axles are rejected. An operator at the dismount press controls disposition of wheels and axles by pushing buttons.

After the axles are cleaned, they are automatically fed on demand into storage racks for one of three Sellers lathes, *Fig.* 4. Loading arms transfer one axle at a time into a lathe, where the axle is picked up on spring-loaded centers and gripped between friction drive plates at a predetermined end pressure.

Each end of the lathe is equipped with an automatic self-adjusting control designed to finish the journals and end collars of used axles to one of six diameters and to remove a minimum of stock to true up wheelseats, dust guard seats, and end collars. Each self-adjusted control is based on a 7-point probing mechanism which determines the template to be traced. The template is electrically traced by a two-dimensional tracer, with cutting performed by three separate tools.

Upon completion of the turning operation, tool slides retract, spindles stop, an axle elevator rises and dwells while right hand head and left spindle center retract; then the elevator finishes its upward stroke, and the axle is deposited on the outgoing conveyor rack. The return of the elevator to the bottom of its stroke completes the cycle and signals for the loading of another axle. The complete lathe cycle of automatic loading, probing, cutting, and unloading requires about 10 minutes.

Among the used axles stripped of wheels on the dismounting press, 15 to 25 per cent are not reusable. New axles must therefore be processed in the wheel shop too. When new axles are being run, a preliminary rough turning operation is performed on the first turning lathe. The rough turned axles are then stored in a rack from which they are

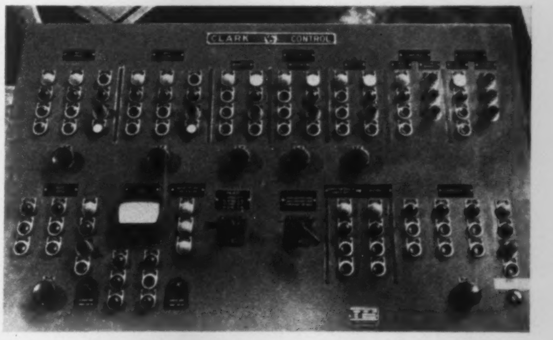


Fig. 2—Except for wheel dismounting and visual inspection operations, the automated wheel shop is controlled from a single central control panel.

fed to the line in the same manner as used axles from the cleaning machine. New axles are fed through the cleaning machine and rough turned on the one lathe while the rest of the line is shut down. With that lathe reset for finish turning, the rough turned axles are drawn from storage and carried through the line in the same manner as used axles.

Axles which have been finish turned are conveyed from the three lathes to a Sellers burnishing machine, *Fig.* 5. One burnishing machine is sufficient to handle the output of all three turning lathes. The burnishing lathe has hydraulic feed of carriage and cross slides, and applies hydraulic pressure to the burnishing rolls. Automatic lubrication of surfaces to be burnished is provided at the beginning of the rolling operation. This machine automatically burnishes the end collars, journals, dust guard seats, and, if desired, wheelseats. Forty sequences occur during the burnishing operation, making this a fascinating machine to observe. The loading and unloading cycle of the burnishing machine is similar to those on the turning lathes.

Burnished axles are transferred to a Magnaglo inspection station. By observing each unit under black light, an inspector determines whether or not the axle is defective. He presses buttons to route defective axles to a reject area and acceptable axles to a first automatic measuring station, *Fig.* 6.

Selective Matching

In the first measuring station, a length measurement is made to determine the classification of the axle. The diameter of the wheelseat is also sensed. This information is displayed by signal lights on a panel in the wheel storage area. A worker loads a wheel, of the classification and size called for by the signal lights, onto each of two wheel conveyors. The wheel loader also records the wheel numbers. The two conveyors carry the wheels to two Betts wheel boring machines, *Fig.* 7. As the wheels advance on their conveyors, they trip limit switches which cause the axle to be transferred out of the first measuring station and the next axle to be moved in to repeat the wheel selection cycle.

The axle for which two wheels were selected moves into a second measuring station, before the wheels are bored. This second measuring station, *Fig.* 8, has two calipering devices, one for each end of the axle. Each calipering unit measures the wheelseat on one end of the axle. Since each calipering unit is geared to a control transmitter, a voltage signal is provided to set the boring machine which bores wheels for the associated end of the axle.

A wheel to be bored is elevated from the incoming conveyor and clamped in a 3-position turntable. Simultaneously, the finish-bored wheel is elevated from the chuck table of the wheel borer into a

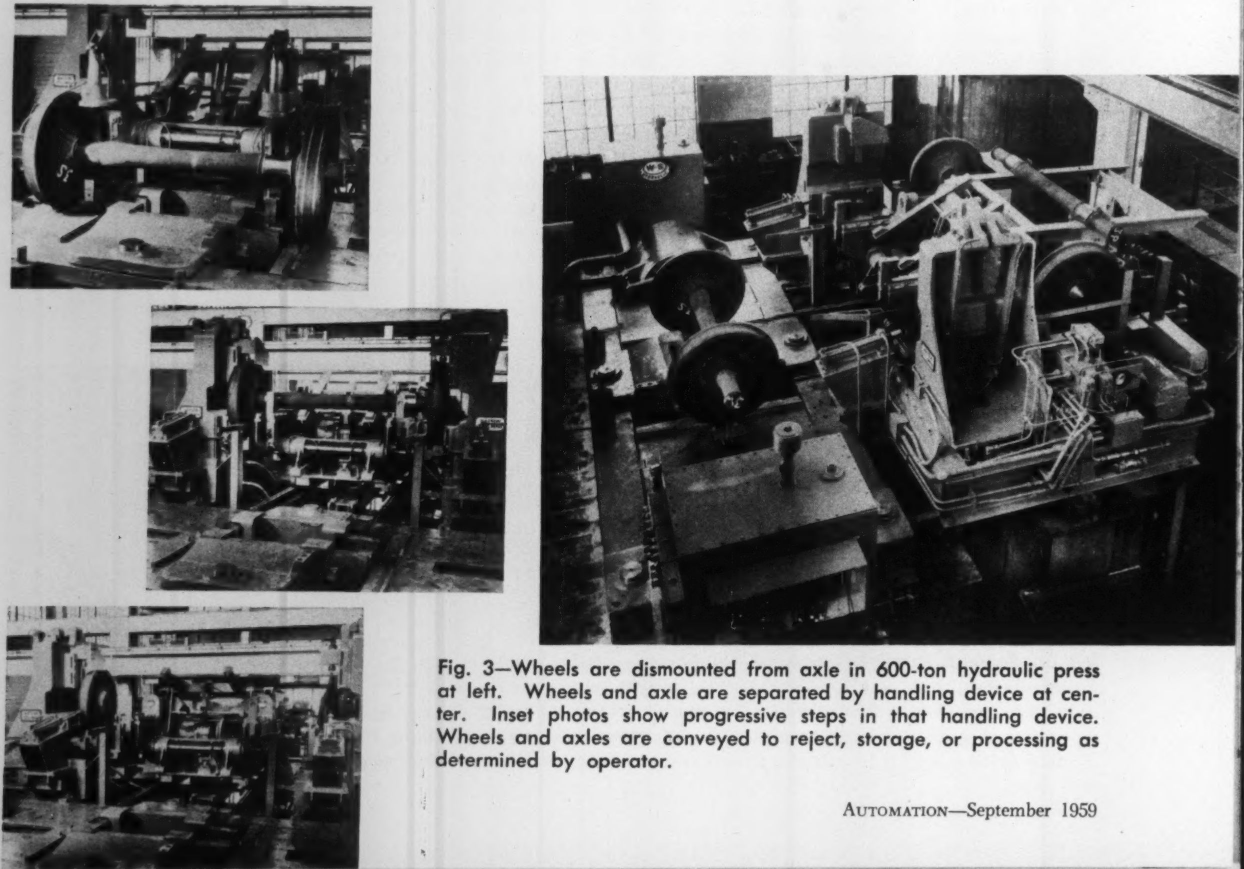


Fig. 3—Wheels are dismounted from axle in 600-ton hydraulic press at left. Wheels and axle are separated by handling device at center. Inset photos show progressive steps in that handling device. Wheels and axles are conveyed to reject, storage, or processing as determined by operator.

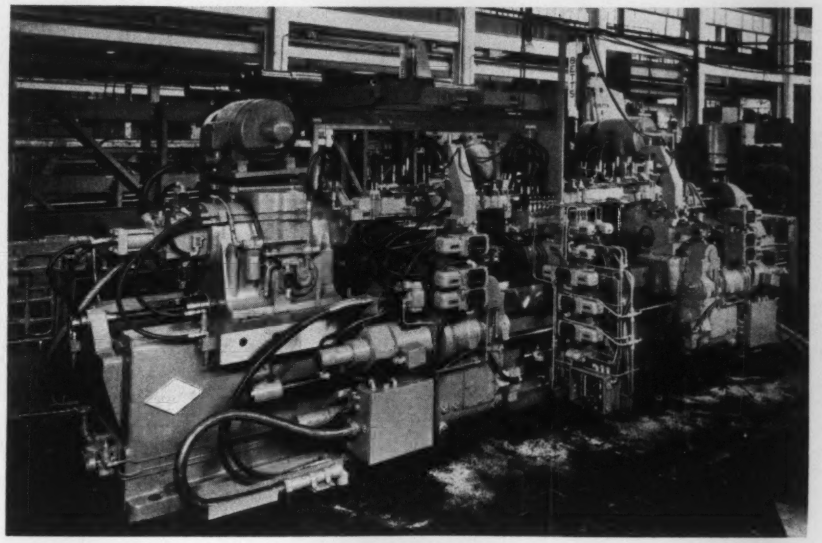


Fig. 4—Both ends of each axle are machined in one of three automatic lathes similar to this one. Cutting tools for each end are controlled by tracer devices in which templates are automatically selected by probing the workpiece. Demand feeding arrangement and storage bank at each lathe promotes operation at high efficiency.

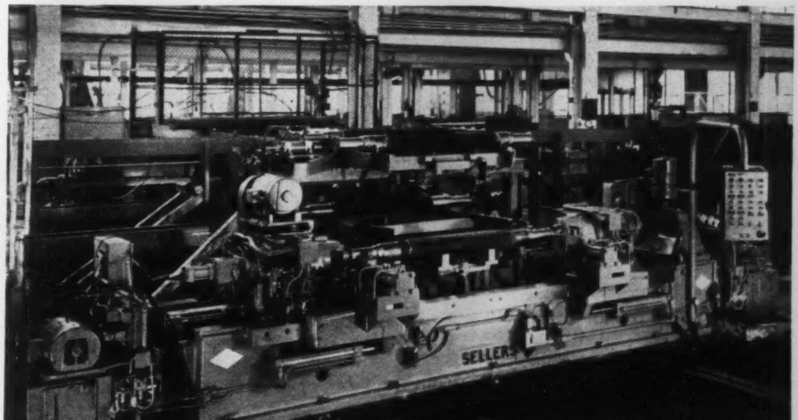
second position on the turntable. When the turntable is rotated 120 degrees, the finished wheel is delivered to a conveyor, and the next wheel is positioned over the chuck table. The wheel is lowered into jaws and chucked; the chuck table rotates; and the boring bar rough bores, finish bores, and chamfers the wheel.

Before the ram of the wheel borer can traverse down, the sliding column must be accurately positioned for boring the wheel to the required interference fit with the wheelseat measured on the mating axle. This setting is obtained by positioning an adjustable wedge at the rear of the machine so that the hydraulically-actuated sliding column is stopped by the wedge. Positioning of the wedge is accomplished by a hydraulic cylinder in which flow is controlled by a servo valve actuated by voltage signals from the caliper and a feedback circuit.

At completion of the boring operations for each set of wheels, a signal causes the advance of the matching axle out of the second measuring station. The wheels are gravity conveyed to a station where they can be tipped up onto their rims, *Fig.* 9. When a satisfactory signal is received from the wheel mounting press, the wheels and axle are moved toward the press. The wheels are tipped up, the wheel bores are lubricated, and the wheels roll into chucks on the press. The axle rolls over an arrangement that applies white lead for lubrication of the wheelseats. The axles are automatically positioned endwise before they are moved into the mounting press.

After a loading arm swings the axle into position, rams move through the wheel bores and pick up the axle on centers, *Fig.* 10. The pressing cycle begins by pushing one wheel on the axle to a fixed

Fig. 5—Storage banks and a preferential control system provide interlocked movements of axles from the three turning lathes to this burnishing machine, with a minimum of waiting for handling operations. Rollers on this machine burnish the end collars, journals, dust guard seats, and, if desired, wheelseats.



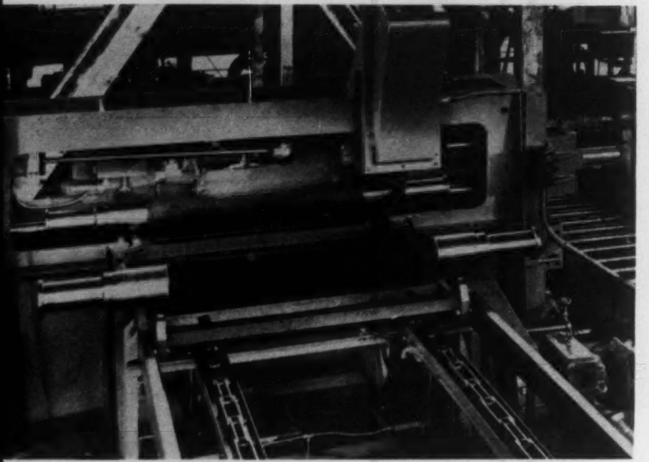


Fig. 6—Axles found acceptable in a Magnaglo inspection operation are moved to the measuring station shown. In this first measuring station, the length of the axle and size of wheelseat are checked and lights in the wheel storage area automatically signal for wheels of the proper classification and size.

position with relation to axle length. The second wheel is pressed to over-all mounting gage with respect to the first wheel.

The mounting press is a 300-ton Watson-Stillman unit equipped with an automatic device to signal the master control station whenever too much or too little pressure is exerted in relation to the distance a wheel has moved onto its wheelseat. Pressures are also recorded with relation to each stroke. This record chart, with corresponding wheel number, is retained in a permanent file.

Pushbuttons on the master control panel allow the operator to switch the operation of this press from *Automatic* to *Manual*. He can manually control the extent of the pressing action for reject sets on which pressures fail to meet specifications. It is desirable to mount both wheels even on sets rejected here since a mounted set is easier to handle.

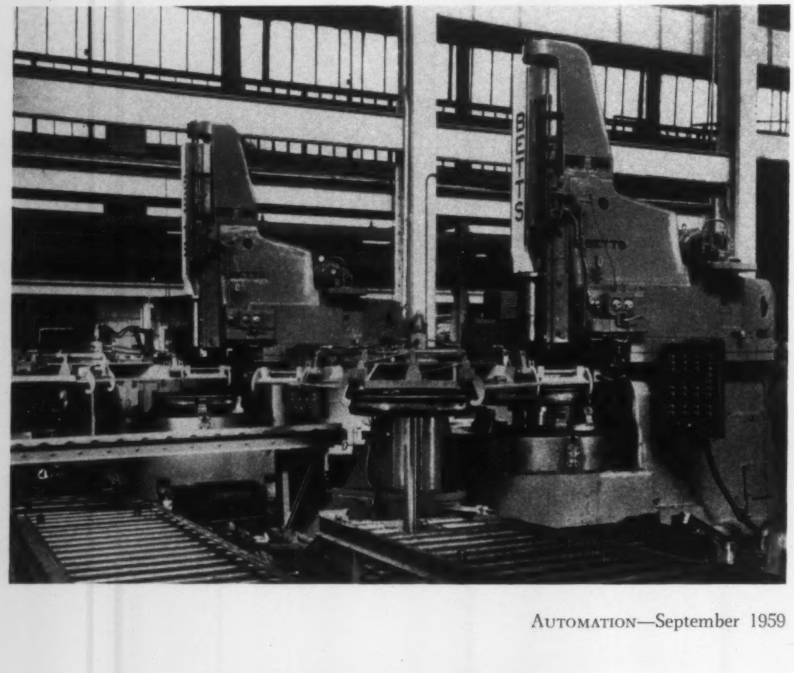
Acceptable mounted sets pass from the mounting press to a station where a rust preventive is automatically applied to exposed machined surfaces of the axle. The completed wheel set can then be stored outside until it is used.

Demand Handling

Basic policy in design of the handling system was to perform the handling functions automatically wherever feasible. One key to the success of the system developed was to provide storage banks in the line to supply and receive workpieces on demand. The first of these automatic storage racks receives axles from the cleaning machine. This rack will hold four axles. When it is full, a limit switch is held actuated and the cleaning machine does not cycle.

Axles are released from that storage bank to a dolly on a conveyor that can deliver them to three similar storage banks at the turning lathes. The dolly is normally parked at the cleaning machine bank. It accepts an axle upon signal from a cleared limit switch on any one of the racks feeding the lathes. Until the storage racks for all three turning

Fig. 7—Wheels are conveyed from the storage area to two wheel boring machines. A wheel for one end of the axle goes to one borer; the wheel for the other end goes to the second borer. Setting of the boring tool is automatically adjusted to fit the wheelseat on which that wheel is to be mounted.



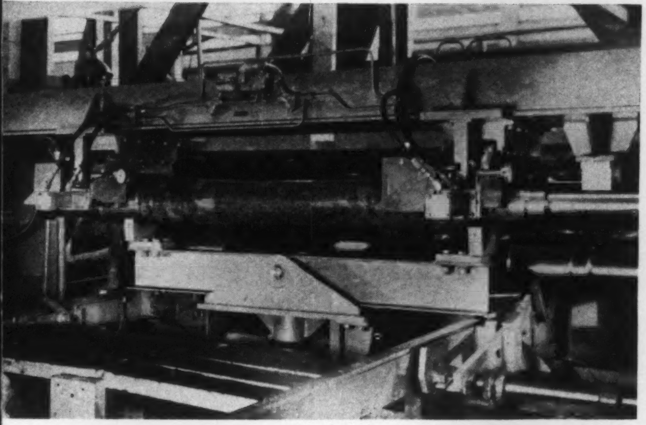


Fig. 8—This second measuring station is used to accurately measure the size of wheelseat for which a wheel is to be bored. A caliper device produces a voltage signal which controls the related boring machine. By switches at the central control panel the operator can adjust the calibration of this boring control.

lathes are filled, a preference signal system will operate so that axles are conveyed in turn to each storage rack. When each rack has been filled with four axles, the dolly will thereafter deliver an axle to whichever rack has an open space.

When set up to do so, this conveyor similarly draws rough-turned new axles from a storage bank that can hold 50 axles. This rack receives axles from the first turning lathe when it is being operated to rough turn new axles.

Axles that have been turned are elevated from the lathes and released to outgoing storage banks. A dolly on another conveyor takes axles from these three racks to a storage rack feeding the burnishing machine. In the case of the first lathe, axles can also be moved to the storage rack for rough-turned new axles.

A preference signal system allows delivery of one axle in turn from each rack at the turning lathes to the bank at the burnishing machine until that 4-axle bank is full. As the burnishing machine takes axles from that rack, preference is given to drawing an axle from any finish-turned rack that has a full load of four axles. Idle time on the turning lathes due to lack of storage capacity is thus eliminated.

Handling arrangements at the burnishing machine are similar to those at the turning lathes, except that the burnishing lathe receives axles from an upper storage rack and releases burnished axles to a lower rack. Axles are released from that lower rack, on demand, to a third conveyor equipped with two dollies approximately 25 feet apart. The two dollies permit transfer of an axle from the burnishing ma-

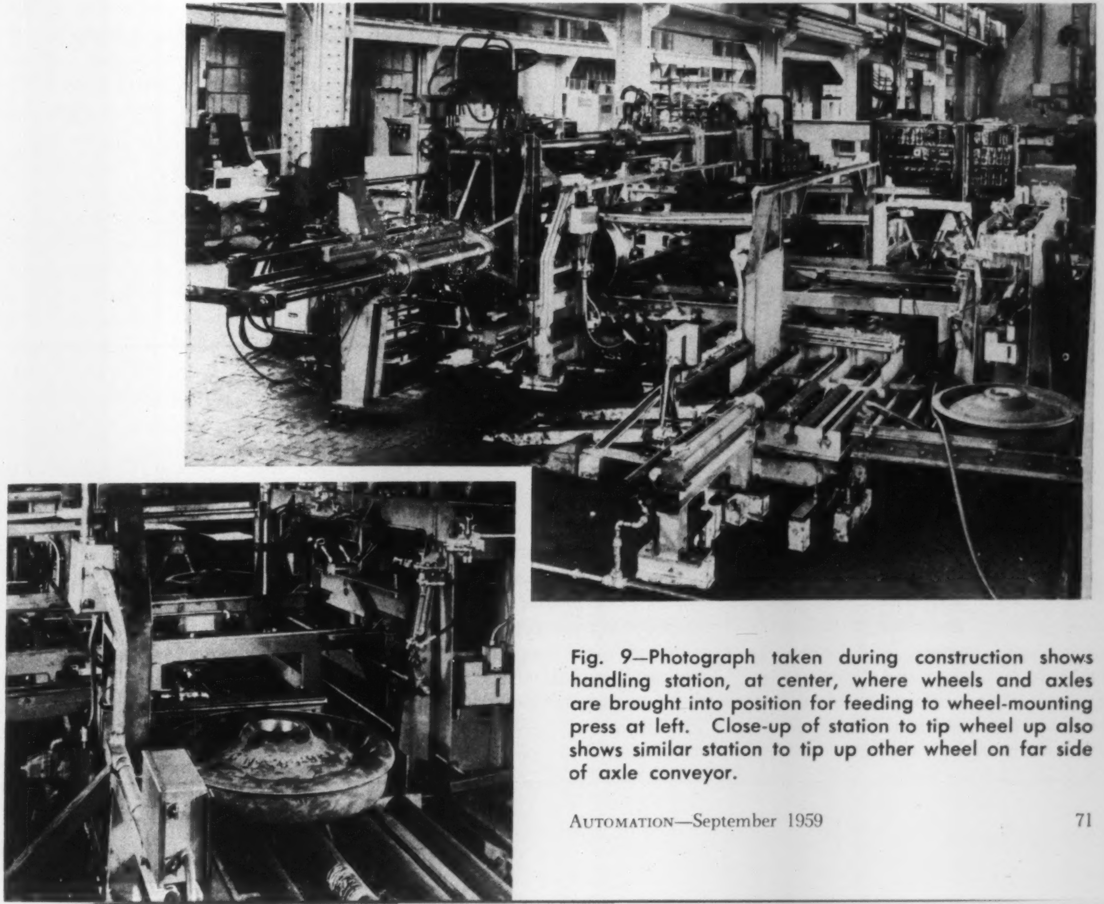
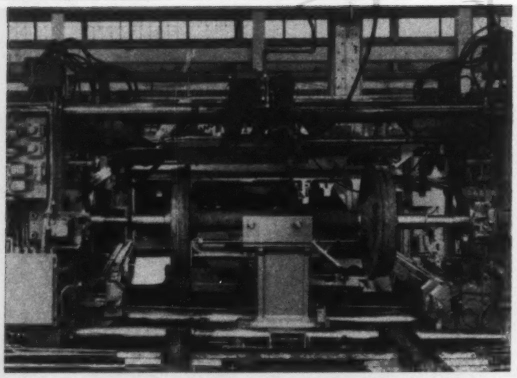
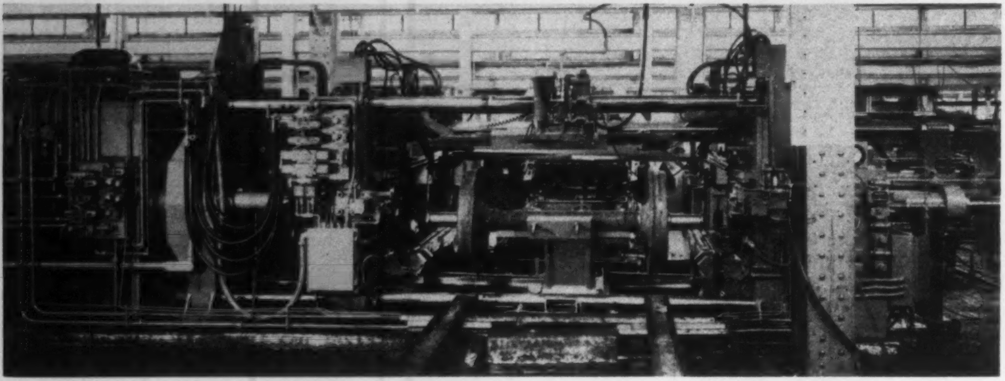


Fig. 9—Photograph taken during construction shows handling station, at center, where wheels and axles are brought into position for feeding to wheel-mounting press at left. Close-up of station to tip wheel up also shows similar station to tip up other wheel on far side of axle conveyor.

Fig. 10—Wheels are press-fitted on axle in automated line to produce wheelset. In close-up view, two rams are still gripping the ends of the axle after wheels have been pressed into place. Larger photo shows wheelset ready to be released.





chine to the Magnaglo station at the same time an inspected axle is transferred to the reject station or to a storage position for a fourth conveyor. By pushbuttons, the inspector at the Magnaglo station controls the movements of the dollies to and from that station.

The fourth conveyor advances axles from a 4-axle storage position to the first measuring station. When an axle is released from that measuring station it enters a 5-axle storage bank which feeds the second measuring station. Another axle is immediately moved into the first measuring station since the dolly on the fourth conveyor is parked next to the measuring station with the next axle. Unloading of the first measuring station and operation of the fourth conveyor is triggered by the movement of wheels, from storage, for the measured axle. Further advance of axles and wheels is interlocked with the operating cycles of the wheel borers and the wheel mounting press.

are you stuck?

Since its inception Automation has helped increasingly in the solution of hundreds of widely diversified practical problems in making manufacturing operations more automatic. Regardless of the character of the operation or system being developed, somewhere in industry a similar problem has been solved and, very often, equipment is available from reliable builders or suitable techniques are known to specialists.

Development can be simplified, engineering costs reduced, and reliability guaranteed with tried and proved equipment and devices available today for achieving successful automation. Whether the problem is simple or complex, practical or technical, if you have not as yet seen the answer to your need in the pages of Automation the Editors will be pleased to make special effort to help find the right answer. The vast reservoir of industrial know-how is yours for the asking. Take advantage of this reader service. Write to: The Editor, Automation, Penton Bldg., Cleveland 13, Ohio.

AUTOMATIC SYSTEMS TESTING

Defense requirements have stimulated and hastened the development of many automatic techniques of value to all industries. Numerical control is an outstanding example. Here the authors discuss another: Techniques for automatic testing of systems composed of complex arrangements of electronic, pneumatic, hydraulic, and mechanical components.

By G. B. WAY and MARTIN RUBIN
Chief, Special Products Section — Supervisor, Automatic Checkout Unit
Computers and Controls Engineering
Autonetics, Div. of North American Aviation Inc.

INTRICACY and diversity of the equipment contained in today's weapon systems are staggering from the standpoint of testing and checkout. The modern system is a complex aggregate of devices—electronic, hydraulic, pneumatic, mechanical, and all combinations thereof. And as complexity has increased, the methods of manually testing have become so time-consuming and costly a process that weapon effectiveness is seriously impaired.

The basic approach to the over-all problem would be to eliminate the need for testing by improving the reliability of the equipment. Unfortunately, system reliability is a function of the ratio of component reliability to system complexity. Both of the factors are increasing concurrently. Until reliability is absolute, then, some improvement over present day testing techniques must be found to ensure reliable systems. The key to improvement is apparent from the nature of the problem.

In a sense, the checkout problem is one of data processing. Large amounts of data in the form of operator instructions must be read and interpreted in order to properly perform the required tests. Further amounts of data must be obtained from the tested system as a function of its responses. Finally, this data must be processed for evaluation and com-

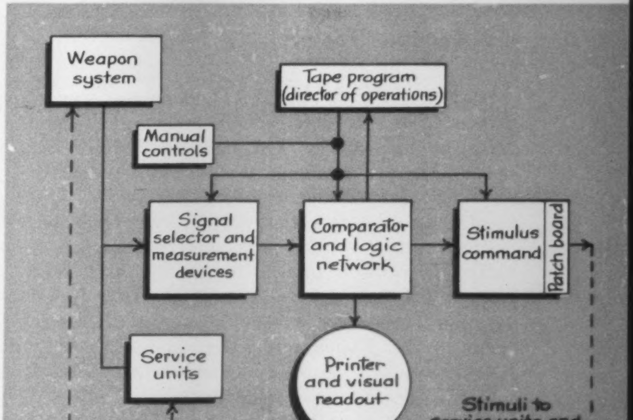

Weapon system
Tape program (director of operations)
Manual controls
Signal selector and measurement devices
Comparator and logic network
Stimulus command
Patch board
Service units
Printer and visual readout
Stimuli to service units and weapon system

Fig. 1—Basic automatic test center includes components to perform functions indicated in block diagram. Such a center will connect various components together in a desired arrangement, measure indicated variables, and evaluate results in accordance with a pre-established program.

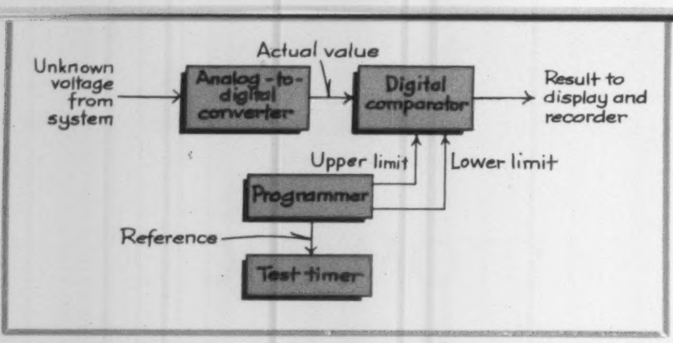

Unknown voltage from system
Actual value
Analog-to-digital converter
Digital comparator
Result to display and recorder
Upper limit
Lower limit
Programmer
Reference
Test timer

Fig. 2—Components within a basic system that enable a fixed voltage to be measured and evaluated are shown. Test timer provides a set time interval which allows system to reach steady state before a measurement is made.

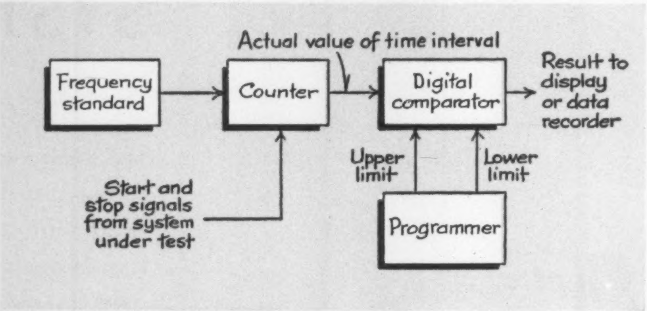

Actual value of time interval
Frequency standard
Counter
Digital comparator
Result to display or data recorder
Upper limit
Lower limit
Start and stop signals from system under test
Programmer

Fig. 3—Time interval between occurrence of two actions within a system can be tested by indicated arrangement. Signals from system under test control the operation of the counter provided with a standard pulse input. The accumulated count is compared to acceptable values.

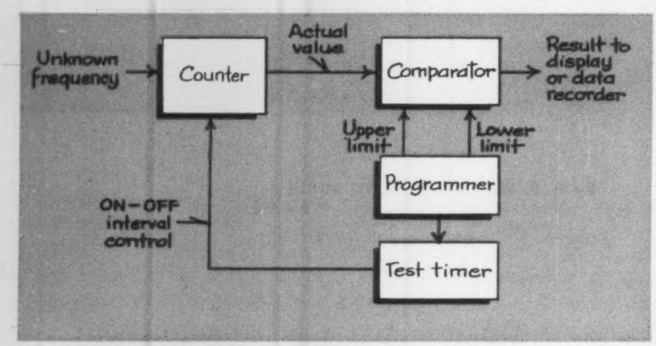

Unknown frequency
Counter
Actual value
Comparator
Result to display or data recorder
Upper limit
Lower limit
Programmer
ON-OFF interval control
Test timer

Fig. 4—Variation of circuit in Fig. 3 enables unknown frequency to be measured. In this arrangement a precise interval of time is established by timer which gates frequency counter on and off.

parison to yet another set of data representing proper system performance. Automation of the processing of these data, together with the means by which it is obtained, is an acceptable solution to weapon system testing problems.*

Common Factors

A tabulation of systems versus test functions, Table 1, reveals that certain tests are almost universal in application. The devices used to perform these tests are common denominator elements for any checkout equipment and can serve as building blocks for an automated test center. Over 65 per cent of all the tests performed consist of measuring ac or dc voltage, frequency, and time. A combination of devices to measure these functions, together with some automatic means of connecting them to the system under test and evaluating the results obtained, forms a central core of equipment which can serve as a basic test center, *Fig.* 1. The automated basic test center includes programming equipment, voltmeters, counters, timers, and evaluators.

Programming equipment is required to translate stored instructions and information into a set of uniquely defined electrical signals. Analog or digital techniques, or both, can be used for storage and translation. Since digital methods have certain advantages in the domain of storage and handling, data processing and evaluation will be based on digital techniques. The voltmeters then become digital voltmeters, or rather, analog-to-digital converters (ADC's), and the evaluators become digital comparators capable of taking an actual value in digital form and comparing it to digital numbers representing upper and lower limits. The comparator output is then *Hi* (above an upper limit), *Go* (between upper and lower limits) or *Lo* (below the lower limit).

Some basic routines that this elementary center can perform are shown in *Fig.* 2, 3, and 4. In *Fig.* 2, a fixed voltage is being measured and evaluated. The programmer, by a medium such as punched cards or tape, furnishes information which is decoded into a set of instructions in the form of electrical impulses. The instructions energize switching devices to interconnect the system test point,

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*This article contains information which is the subject of pending patents.

ADC, test timer, and comparator. Upper and lower limits, as well as test time information, are processed from the program medium. The test timer is a programmable clock used to set time intervals which allow a system to reach steady-state before a measurement is made. At the programmed time the digital output of the ADC is compared to the upper and lower limits in the comparator and the results (*Hi, Go, Lo*) as well as the actual value of the measurement are displayed or recorded. In *Fig.* 3 the interconnections are shown for measuring the time interval between, for example, two relay closures. Here a frequency standard serves as a clock to time the interval as a counter is gated by the system under test. The accumulated count is evaluated and processed as before. In measuring an unknown frequency, the frequency standard of the previous example is replaced by the unknown frequency to be measured, *Fig*. 4. A precise interval is generated in the test timer and used to gate the frequency counter on and off.

The test center will generally require some auxiliary equipment to adapt it to the systems under test. It is in these "adapters" that such items as impedance matching devices, switch matrices, cable plug terminations, special-purpose signal generators, and signal converters are located.

▶ Equipment Operation

Experience has shown that for a complex weapon system considerably more is needed than the basic test center. For example, one experimental operational test center consisted of: 1. Programmer. 2. Logic-decoder for information processing, automatic start and stop of programmer, address decoding, etc. 3. Counters, timers, and registers. 4. Analog-to-digital converters. 5. Comparators. 6. Control panel with visual displays. 7. Data recorder. Such a test center can—through a suitable adapter set—select test points, command and scale signals to be generated, measure system responses, evaluate results, and make decisions for future action based upon the obtained results. For example, during a fueling operation a marginal indication of fill rate might be suitably ignored and checked again later, while an open dump valve indication would call for immediate safe shutdown of the entire operation.

A functional block diagram of the test center, *Fig.* 5, illustrates the major lines of flow control and information. In this diagram the programmer delivers digital data to the logic and decoder block for processing. Two types of data must be decoded: Numerical information to be used during the test

TABLE—1
Required Tests for Representative Systems

Test function	Radio altimeter	Radar altimeter	Glide slope receiver	Beacon marker	VOR	TACAN	LORAN	Direction finder	Radar beacon	HF communication	UHF communication	Intercommunication	ECM transmitter	ECM receiver	Pulse analyser	X-band radar	Doppler radar	L & L computer	Gyro computer	LABS	Flight control	Armament control	Bombing/navigation	Pulse generator	Electrical system	Autonavigator	Doppler navigator	Air data computer
D-c voltage	1	6	5	1	6	2	4	1		10		1	1	1		3	14		5	12	26		5	2	2	2	10	4
A-c voltage	1	4	2	7	7	1	2			11		1		1	1	4	9		2		48		2		2	3	7	6
Frequency meter	1	1				4	2	2		8	1		1			3									2		1	
Time counter	1					2	6			3					1	6	3		1	2	19		6			1	1	1
D-c signal source			2		4					5											8		1			1	2	
400-cps signal source																					22		1			1		
Low frequency oscillator																					4							
R-f signal source			5		5			2	5	5				4		3												
Synchro transmitter																1		7					1				4	
Flight table																					20							
Barometric console																					5							3
Echo box	1	2																			1							
Control timer		1																	3		1		2			1		
Ramp generator																					4							
R-f power meter	1	1		3	2	8			7		2		4	2		4	2											
Servo analyser																					1				1	1		
Phase rotation box																			1				1		1			
Resistance meter							1														3		1			1		
Pulse generator									8						8													
Synchro receiver																							4				2	2
Audio oscillator																					1							

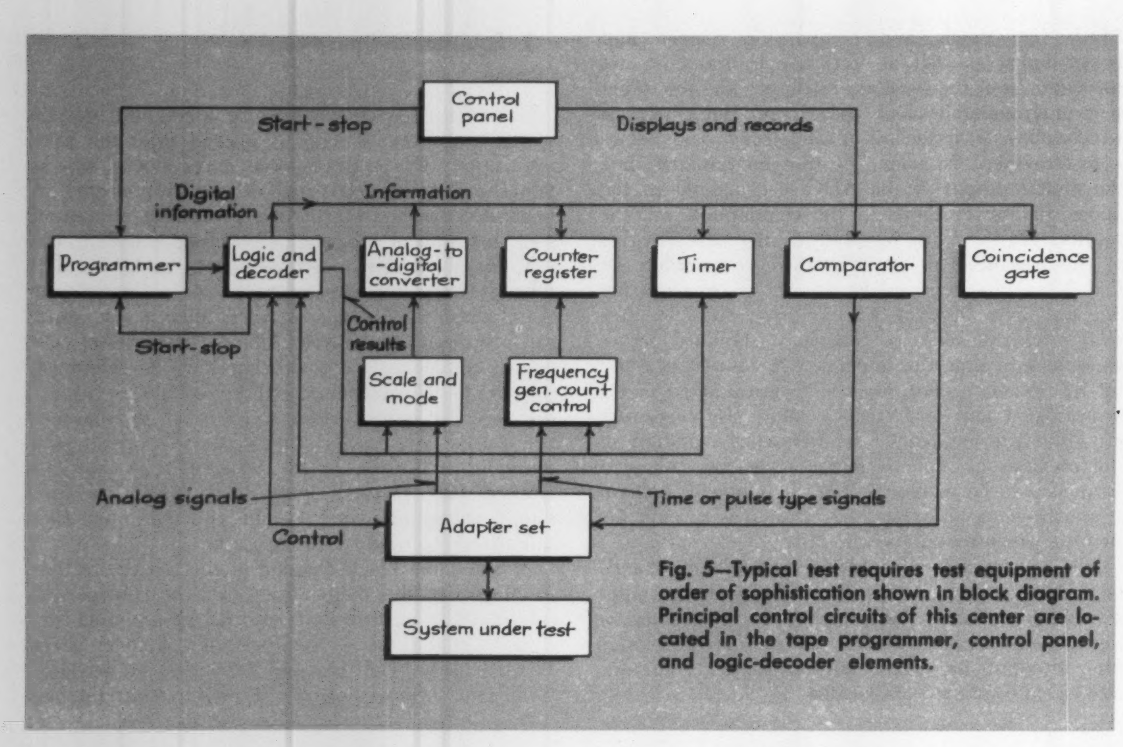

Control panel
Start - stop
Displays and records
Digital information
Information
Programmer
Logic and decoder
Analog-to-digital converter
Counter register
Timer
Comparator
Coincidence gate
Start-stop
Control results
Scale and mode
Frequency gen. count control
Analog signals
Time or pulse type signals
Control
Adapter set
System under test

Fig. 5—Typical test requires test equipment of order of sophistication shown in block diagram. Principal control circuits of this center are located in the tape programmer, control panel, and logic-decoder elements.

(5 volts upper limit, measure for 10 seconds, etc.) and data which constitute instructions (connect the ADC to test point 39, transfer the ADC output into a memory register, close relay K12 in the system under test, etc.). The logic-decoder then processes the programmer data into information and control instructions for use by the rest of the system. Programmed address instructions flow out of the decoder on control lines to select and scale the appropriate signal generators and analyzers in the adapter set. Additional addresses select test points and route them back to the test center. By the same process the test center is scaled, time functions set up, and information links closed to convert the return signal into a digital form which can be processed by the comparator. The results of the comparator evaluation are returned to the logic-decoder for a decision. Three types of decisions cover almost all situations. These are: 1. Proceed to the next test. 2. Stop the test at this point and await operator commands. 3. Enter a special subroutine. Visual displays and digital printers keep the operator informed of the test status and provide a permanent record for future failure analysis.

The logic and assumptions behind the automated test center can be deduced from the diagram, *Fig.* 5. Most important is the assumption that all instructions and all information can be encoded onto a stable program medium. Following this is the assumption that the instructions and information can be arrayed in an orderly sequence which is nonambiguous. Given these two conditions, the mechanization of the test center becomes a process of logical design and electromechanical development.

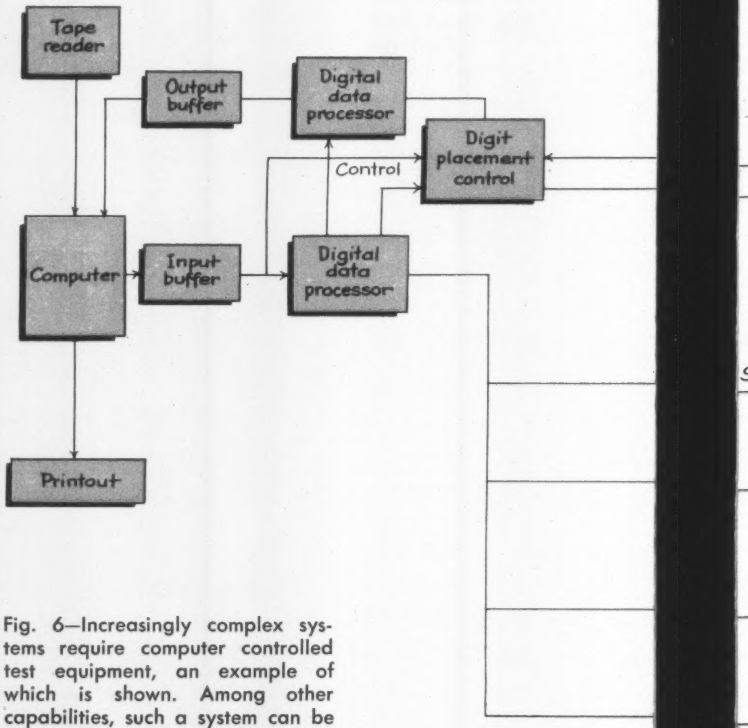
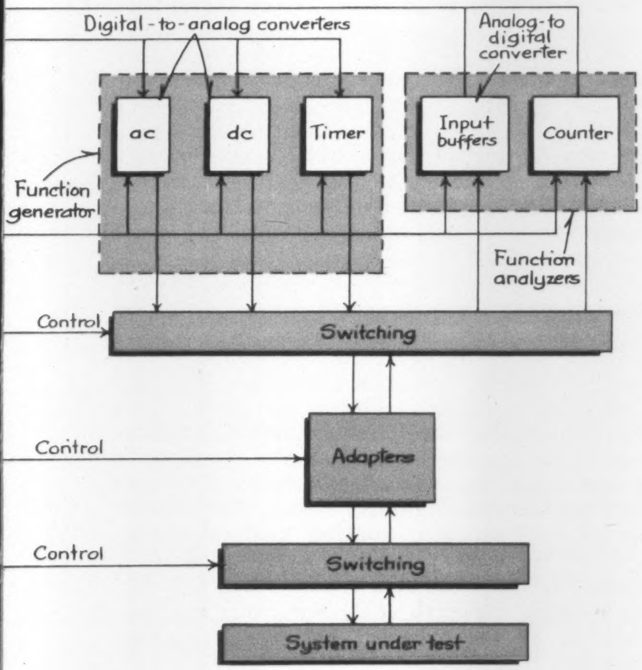

Tape reader
Output buffer
Digital data processor
Digit placement control
Control
Computer
Input buffer
Digital data processor
Printout

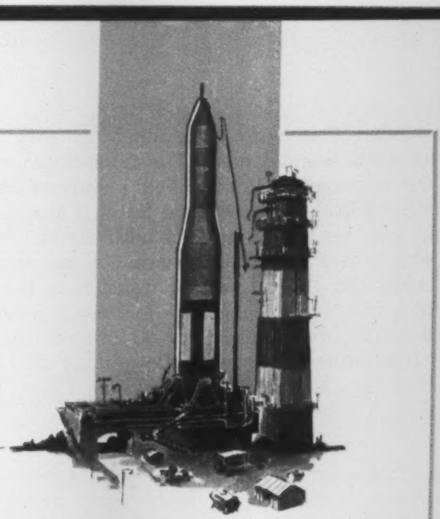
Fig. 6—Increasingly complex systems require computer controlled test equipment, an example of which is shown. Among other capabilities, such a system can be self-checking, distinguishing between failures in system being tested and failures within the test equipment.

For the programming medium an eight-hole punched tape has been chosen. This meets the conditions of stability and orderliness of sequence. Recovery of information from the tape is accomplished by a tape reader translating the holes into electrical impulses. It is these impulses which must be interpreted into useful commands and numerical information. The logical designer comes into his own at this point since he must choose a code which will carry a maximum of information without requiring prohibitive amounts of interpreting electronics. The code must be reasonably simple to program. Tape is decoded by a process in which the tape-reader impulses are translated by a diode matrix into unique signals on particular wires in the test center.

The primary functions of the test center shown in *Fig.* 5 are to control adapters during a test and to measure and compare signals from the system under test. Principle control circuits of the test center are located in the tape programmer, the control panel, and logic-decoder. The source of all automatic control, the tape programmer reads punched tape consisting of eight data holes and a sprocket hole per frame. The program is placed on the tape, and coded in the binary coded decimal form with values 1, 2, 4, and 8 assigned. Coding placed on the tape falls into two categories: Information and control.

The term "information" as used in the system, means a number that retains its identity as a number at all times, such as an upper limit, a time interval instruction to the timer, a test number, etc. When the frame is read off the tape, the information is routed to an information line by the logic-





A TYPICAL TEST

THE CONNECTING of several components by the test center logic, so that the equipment will compare various measurements, involves routines, i.e., basic commands that can be combined in various ways to form a test program. Typical routines are: Compare a voltage with limits—Stop machine and signal operator—Stop machine for manual adjustment—Printout results of comparison—Add or subtract numbers—Stop tape for a given time interval—Compare output of counter to limits—Measure time interval—Measure frequency—Enter number in upper or lower limit, or test number.

Monitoring of rocket-engine fueling is a typical test and can be used to illustrate the approach to programmed testing. The sequence of desired events is somewhat as follows: 1. Confirm fill line valves closed, tank vent valves open, dump valves open, and fuel monitor gages read *Empty;* check fuel reservoir content. 2. Start and check pump power system. 3. Engage pumps and check pressures. 4. Close dump valves and confirm. 5. Open fill valves; confirm fill valves are open, dump valves closed, and vent valves open. 6. Set timer limits to desired limit and start timer. 7. Monitor tank gages for tank *Filled* signal. 8. Upon receipt of a tank *Filled* signal, or a *Time Up* signal, whichever comes first, disengage pump. 9. Close and confirm fuel fill valves. 10. If the *Filled* signal came first, proceed with next operation; if the *Time Up* signal came first, stop all operations, alert the operator, measure fuel gages, and printout and display results.

The information is coded onto the tape in the preceding sequence. The tape reader output is decoded and steps the test point selector in the adapter set to the appropriate lines for *On-Off* confirmation. The results are stored as digital words in the register and compared to the desired configuration. If coincidence exists, a *Go* is generated which removes the stop from the program control, starting the tape reader. Further information is then processed into the adapter set for relay operation. Limits are entered into the comparator. Range, reference, and converter selection are made and the analog measurement selector in the adapter set is stepped to the appropriate test lines. An alternate sequence is coded on the tape for use if the estimated time to fill the tanks is exceeded.

decoder. One wire is required for each bit; four for each decimal digit. The information arrives on the information lines, called a bus, at the rate of one decimal digit per tape frame. Once on the bus is can be routed to any element of the system which uses digital information. Tape speed determines the general rate of transfer on the information bus. If it is required to store a number from the tape, the number can be entered into the registers. From the register the number can be routed back into the information bus as a complete four-digit number.

THE AUTHORS

GAROLD B. WAY (left) is chief of the Autonetics Special Products Section, a diversified engineering group developing automatic checkout recording, and data processing equipment. Mr. Way's engineering experience includes design of armament control equipment for anti-aircraft and artillery while serving as captain in the US Army; research and development of geophysical equipment and methods for Phillips Petroleum Co.; civilian chief of ammunition production planning for the Army's Ordnance Ammunition Center, Joliet, Illinois. Mr. Way joined Autonetics in 1952 where his work has included the development of aircraft and missile flight control systems with their associated ground support and checkout equipment. He has also been engaged in the development of data handling and automated production. He received his B.S.E.E. degree from Kansas State College and has done graduate work at Oklahoma A & M.

MARTIN RUBIN, supervisor of the Automatic Checkout Unit of the Special Products Section, is responsible for research and development of components and systems for general purpose automatic equipment. Since joining Autonetics in 1953, Mr. Rubin has pioneered in the application of transistorized circuitry to automatic checkout equipment and has done extensive evaluation work on military electronic equipment. He has pending patent applications on a high-speed binary digital comparator, improved transistor flip-flop, and driving circuit for stepping switches. Before joining Autonetics, Mr. Rubin was test and systems analysis engineer for 5 years at General Electric Co. Mr. Rubin graduated summa cum laude from Clarkson College of Technology with a B.S.E.E. degree and was awarded an M.S.E.E. degree from the University of Southern California. He is a member of Tau Beta Pi.

Data sensed by the tape reader is decoded via a diode matrix into addresses, instructions, and numerical information. An address frame is decoded to activate a function area; the instruction frame is decoded to select a function within an address; and the information frame provides information to that function. To perform an operation, an address frame is followed by one or more instruction or information frames. Memory is associated with the address frame to keep the address activated until the new address is selected.

Selection of measurement points is made by switches which can accommodate voltages ranging from millivolts to hundreds of volts. Two types of measurement points are selectable: Points for quantitative measurements and points to verify the existence or absence of 28-v dc. For quantitative measurements two-wire switching is used to provide a circuit input to the voltage analog-to-digital converter.

The 28-v dc verification signals are used in the logic network to perform functions such as starting or stopping the time measuring unit, commanding the voltage analog-to-digital converter to sample a voltage, or restarting the tape after a programmed stop.

Switches are also used to perform range switching and selection of ac to dc converters for the voltage analog-to-digital converter. When the voltage analog-to-digital converter is used as a ratio measuring unit, the reference voltage for the ratio measurement is also selected by switches.

▶ Increased Demands

There are already in existence weapons systems whose test and maintenance requirements exceed the capabilities of an automatic weapon system testing center which primarily controls events and measures voltage, frequency, and time. Computational facilities become important, for instance, when systems interact in such a manner that the performance tolerances of one depend on the actual responses of another. Self-checking capabilities are of vital importance in the field where little time is available to determine whether it is the system under test, or the test center itself, that has failed. during the testing operation.

Random access programs are playing an increasing role in system requirements where the number of alternate sequences become so numerous as to prohibit the straightforward, either-or type of program. To meet the demands of random access programming, computer-controlled test centers have been undergoing considerable study. In such a center the computer takes over the functions of programming, logic, decoding, comparing, evaluation and, of course, decision making. The number of alternate sequences available now are limited only by the memory and tape storage capacity. A block diagram of one such system is shown in *Fig.* 6, in which almost all of the test center has been replaced by the computer; buffers and adapters remain.

SCREW DRIVING MACHINE ADAPTS TO JOB-SHOP NEEDS

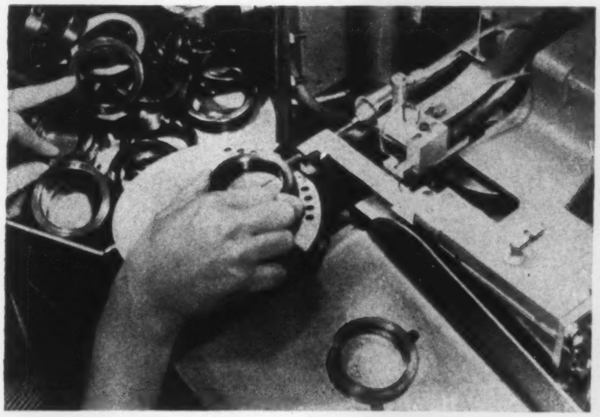
DESIGNED to make up to 2500 insertions per hour, and intended primarily as a building block for an automated production line, an automatic screw driving machine developed by Standard Pressed Steel Co. has proved of value in a job-shop type of operation. SKF Industries Inc. has adapted the machine to a production operation in which from 1 to 2 setscrews are assembled in shaft locking collars. The batch-type operation involves any of 11 different setscrew size and length combinations and more than 20 different collar sizes. The collars are designed to fit over the extended inner rings of ball bearing assemblies in a pillow block application. In use, the setscrews in the collar extend through clearance holes in the inner ring and lock the ring to a shaft.

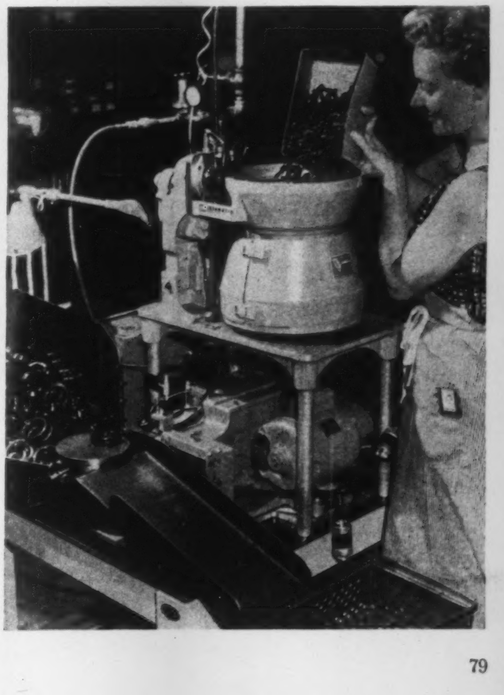
The basic screw driving machine consists of two units: A supply system which picks up setscrews from a vibrating hopper, orients them, and feeds them into a driver feed tube; and a drive mechanism which picks up the setscrews from the feed tube, inserts them into the tapped holes, and tightens them to a preset torque. In the SKF application the setscrews are merely being inserted to make up a collar assembly and, in lieu of being tightened to a desired torque, are inserted to a predetermined depth so as not to protrude into the bore of the collar.

Accessory equipment provided by the user to adapt the machine to his requirements includes a bulk supply point for collars and an adustable holding fixture, which is manually loaded.

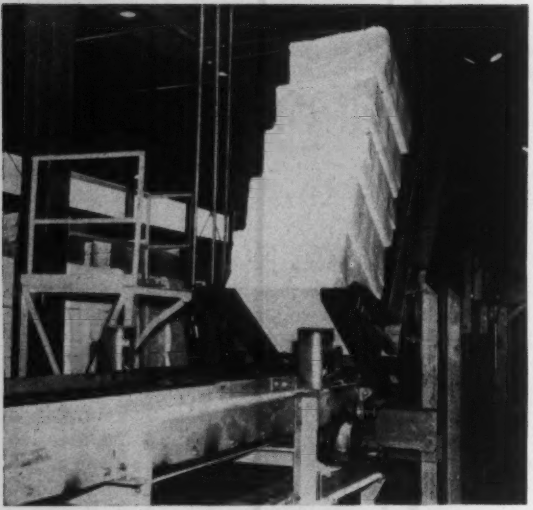
In operation, a setup man adjusts the machine for proper diameter and length of setscrew, and for the proper depth of insertion. The operator places a collar against holding lugs on the adjustable fixture, correctly orienting the collar to receive a setscrew. The machine will cycle automatically, feeding and inserting setscrews so long as the operator keeps a foot pedal depressed. If a poorly tapped hole or damaged screw is encountered, the driver mechanism will automatically shorten its stroke and a slip clutch on the driver spindle prevents damage to both the product and the machine.

The machine is operated by SKF at a rate of 1200 insertions per hour, about half of the designed potential of the equipment. Assembly costs in the mechanized operation average one-third as much per setscrew when compared to hand assembly costs. Typical savings, in terms of rates set for the job: Previously costing 71 cents per 100 insertions by hand methods, setting a 1/4-inch setscrew now costs 23 cents per 100 insertions; a 3/8-inch size formerly costing 94 cents per 100 insertions now costs 27 cents per 100 insertions.





Machine that assembles setscrews to collars contains a bulk supply feeder and a horizontally actuated driving mechanism. As shown in close-up view, operator positions collars against holding lugs on work table; machine will cycle automatically at rate of 1200 insertions per hour so long as a foot pedal is depressed. This application illustrates the broader use possibilities of equipment primarily designed for use in automated lines.

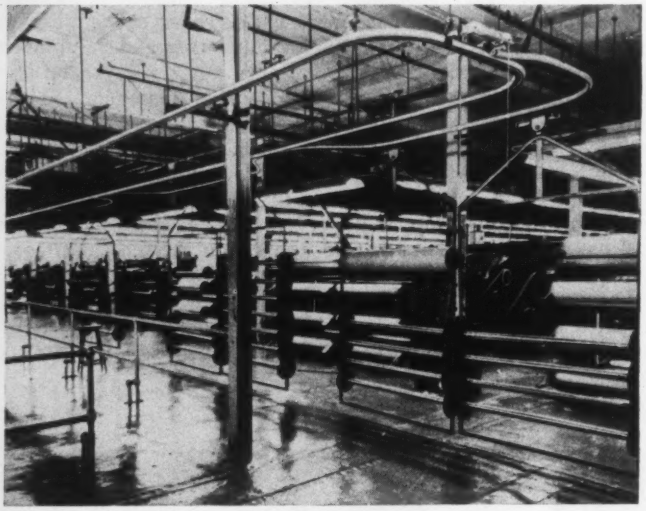


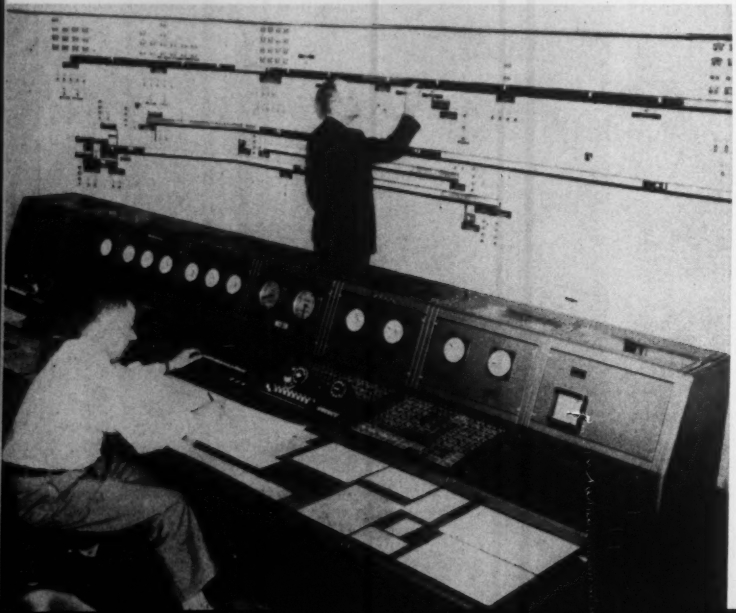
Bundle Stacking

LOADS too soft or irregular to be handled with clamps are automatically stacked by the use of two upenders in a series operation. In this installation by the Lamson Corp., the first upender receives bundles, one at a time, and stands them on end for transfer to a second upender. When five bundles have been accumulated on the second upender, the unit rotates creating a five-high stack. The stack can be delivered to a conveyor as shown or can be picked up by an industrial truck. A photoelectric system controls the operation of the two upenders.

Yarn Conveying

OVERHEAD power-and-free conveyor system is used to move large spools of yarn from a first floor processing area to a second floor spinning operation. Conveying equipment for the Draper Brothers installation was furnished by the Chainveyor Corp. Motivating force to push the specially designed carriers is supplied by pusher dogs mounted directly to a chain conveyor; the carriers travel on track alongside the chain conveyor. Automatic switching is provided by an index flag that can be set to identify loaded carriers.





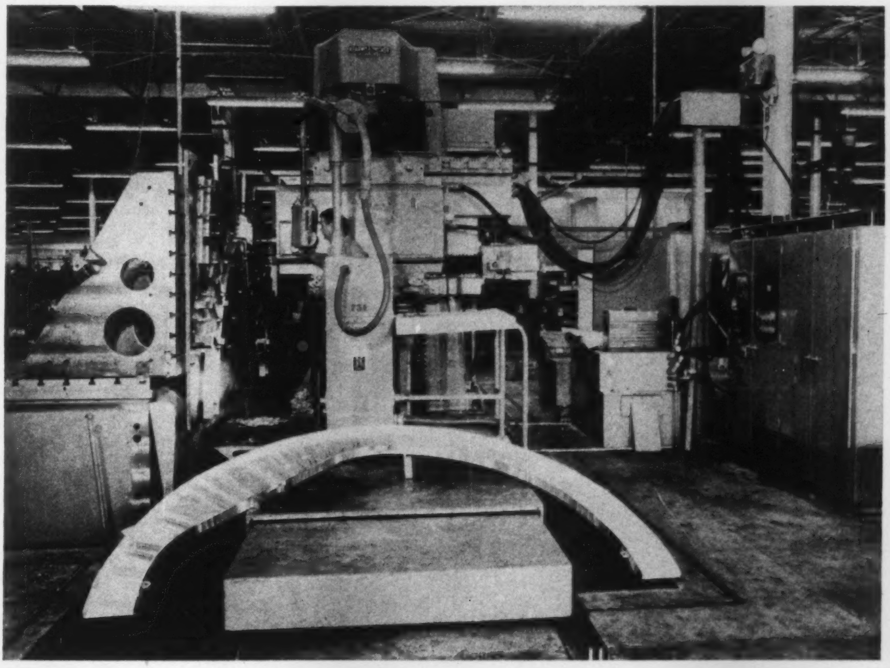
Pipeline Control

VOICE, control, and supervisory channels plus selective telemetering in cross country pipeline operations are supervised from a central point for the Ohio Oil Co. Concerned with movements through the company's crude and refined products lines in Illinois, Indiana, and Ohio, system utilizes microwave communications to transmit information on pressure (suction and discharge) specific gravity, temperature, tank fluid level, and flow from various points to the control center. In operation, individual stations are selected by operator and the transmitted data are read on dials at the console. Display panel behind console helps operator visualize conditions for the entire system, including operation of automatic pumping stations along the crude pipeline. The control center is housed in enclosures supplied by Elgin Metalformers Corp.

in action

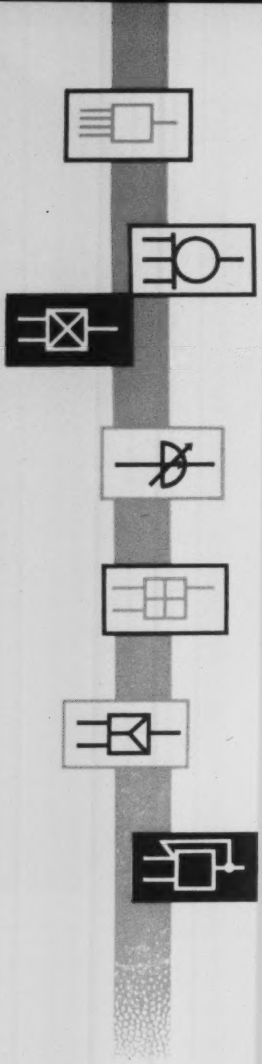
Coal Processing

SYSTEM at a new plant of the Clinchfield Coal Co., Div. of the Pittston Co. is controlled from this panel installation. Ninety per cent of the operations in the plant can be controlled by one man. With equipment supplied by Link-Belt Co., the plant processes up to 1500 tons of coal per hour in a series of operations including cleaning, crushing, sizing, mechanically dewatering, heat drying, and loading into railroad cars.



Missile Machining

NUMERICAL control of a milling machine has enabled H & B American Machine Co. Inc. to increase production and reduce costs of Atlas ICBM thrust bulkheads. The preproduction status of missile manufacturing has created problems for which numerical control has proved an ideal solution. The illustrated Kearney & Trecker three-axis miller utilizes a numerical control system developed by Industrial Controls Section, Bendix Aviation Corp. In machining the bulkhead, the machine performs milling operations around the outside contour, 36 pocket milling operations on one side, and 15 pocket milling operations on the other side of the part. The 500-pound aluminum workpiece is reduced to a finished weight of 49 pounds. Control tape for the Indianapolis application was prepared by Bendix in Detroit.



STATIC CONTROL

. . . AN APPLICATION APPRAISAL

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MACHINES being designed to meet today's production demands are more complex, are operating at higher speeds, and more costly than ever before. The demand for reliability in the control systems of such machines has increased to the point where failures must be virtually nonexistent. Even a simple control failure can result in a work stoppage, damaged material, a damaged machine, or injury to personnel. A control failure of prolonged duration affecting a continuous process or an automated production line can result in the shutdown of a complete factory.

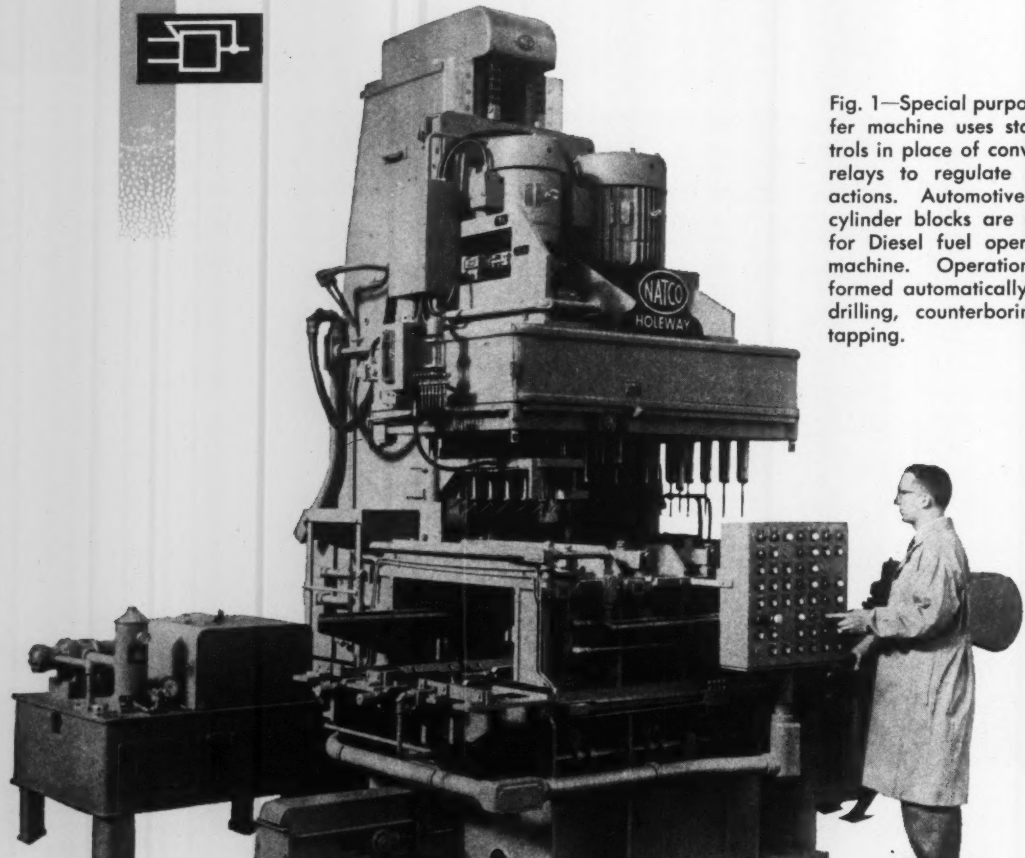


Fig. 1—Special purpose transfer machine uses static controls in place of conventional relays to regulate machine actions. Automotive engine cylinder blocks are adapted for Diesel fuel operation in machine. Operations performed automatically include drilling, counterboring, and tapping.

As performance requirements for machine control systems become more stringent, many manufacturers are considering static controls. Are they applicable in the control of production machines? How difficult is a transition from conventional to static control technology? What about the economics of static control? Such questions are discussed here against a background of experience in converting a conventional machine tool control panel to static control.

This increasing demand for control reliability fostered the development of static controls. Over the past 3 years, thousands of dollars have been invested in the design and construction of static control panels to control various types of equipment. Sufficient data have been accumulated to permit a preliminary appraisal of the claims made for static control. Has it lived up to the hoopla accompanying its introduction?

National Automatic Tool Co. Inc., constantly alert for means of improving their products and the means of control, undertook an investigation of static control shortly after its market debut. During this investigation, they designed and built a special processing machine, *Fig.* 1, which uses static control.

The machine performs drilling, counterboring, and tapping operations on automotive engine cylinder blocks. It is used in a process line which converts standard cylinder blocks for Diesel fuel operation. The machine is typical of small automatic transfer equipment. The control principles applied, and lessons learned from this application, could also apply to other types of machines including large transfer machines of the kind used extensively in the automotive industry.

Workpieces are fed into the machine, transferred through four workstations, and unloaded. As each piece advances to the next station, a new piece takes its place. All work operations are performed with one working head.

▶ Static Versus Conventional Control

A conventional control circuit had been designed previously for such a machine. The circuit used machine tool relays as the controlling means. The cost records for this design were still available showing the engineering and manufacturing times, so that a benchmark was available against which to measure these phases of the economics of static control. In order to facilitate a comparison of static with conventional relay control for this machine, a checklist was compiled showing various time factors contributing to total engineering and manufacturing costs. Relative time figures, TABLE 1, are for the first static control panel built by NATCO. Experience garnered in the construction of this panel would undoubtedly change these estimates for subsequent panels.

▶ Static Circuit Design

The first step in the design was to select the static control system which would be used to control the machine. The NATCO engineering staff considered several factors including customer preference, operator safety, simplicity of design, and system flexibility. The General Electric Co. static control system was found to be suitable for this application, and was adopted.

Since static control was a relatively new medium

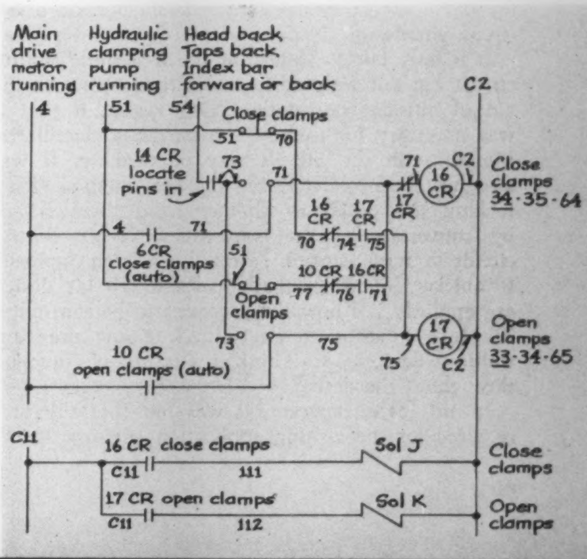

Main drive motor running
Hydraulic clamping pump running
Head back Taps back Index bar forward or back
C2
4
51
54
Close clamps
51
70
14 CR locate pins in
73
71
71
C2
16 CR
17 CR
Close clamps 34·35·64
16 CR
17 CR
4
71
70
74
75
6CR close clamps (auto)
51
10 CR
16CR
77
76
71
Open clamps
73
75
17 CR
75
C2
Open clamps 33·34·65
10 CR open clamps (auto)
C11
16 CR close clamps
C11
111
Sol J
Close clamps
17 CR open clamps
C11
112
Sol K
Open clamps

Fig. 2—Elementary diagram shows portion of conventional relay control circuit for the transfer machine. Manual and automatic control of clamping and unclamping functions are effected with the components diagrammed.

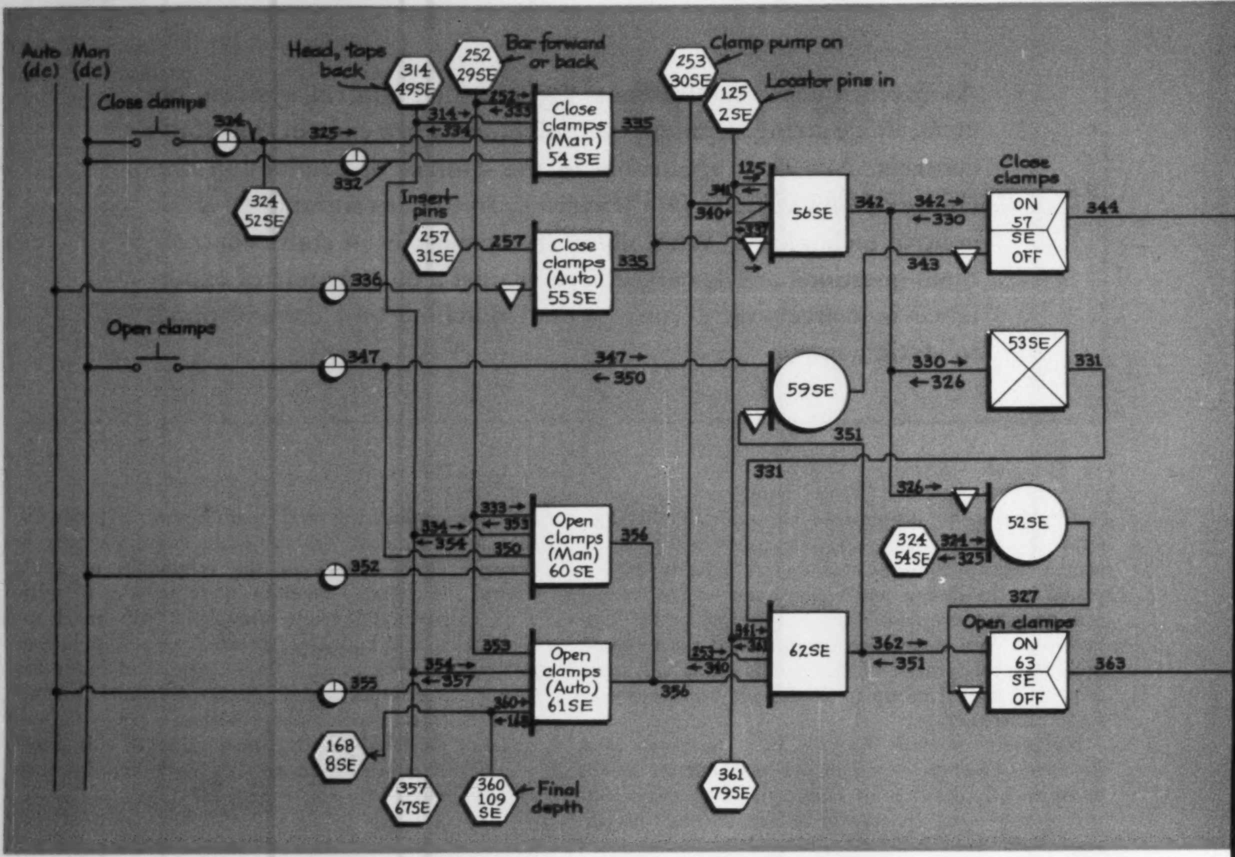

Auto (dc)
Man (dc)
Close clamps
Head, tops back
314 49SE
252 29SE
Bar forward or back
Close clamps (Man) 54 SE
324 52SE
Insert pins
257 31SE
Close clamps (Auto) 55 SE
Clamp pump on
253 30SE
125 2SE
Locator pins in
56SE
Close clamps
ON 57 SE OFF
53SE
59SE
52SE
324 54SE
Open clamps
Open clamps (Man) 60 SE
Open clamps (Auto) 61SE
62SE
ON 63 SE OFF
168 8SE
357 67SE
360 109 SE
Final depth
361 79SE
325
332
336
347
350
352
355
335
356
342
343
344
330
331
326
327
351
362
363
333
334
353
354
340
341

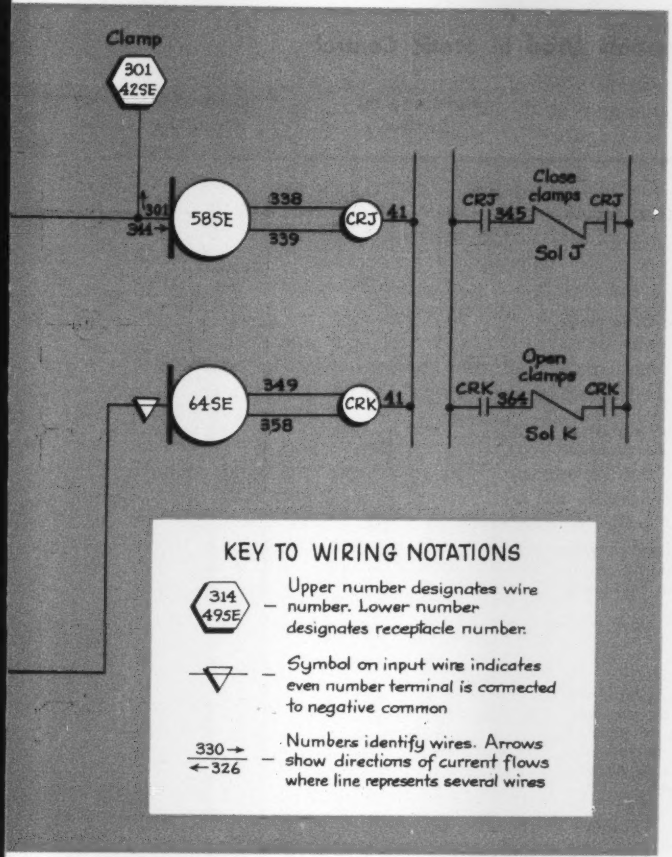
Fig. 3—This portion of static control circuit for the transfer machine corresponds to the relay control circuit of *Fig.* 2. Diagram conforms to NEMA standards recommendations for static control systems, and contains wire designations as well as symbols for logic elements and other components.

for their designers, NATCO felt that the project would be expedited, and its engineering staff would benefit, through full use of consultation service available from GE. Therefore, a GE application engineer was present during the preliminary circuit design discussions. The final circuit design was set up and operated to NATCO's satisfaction on a GE circuit simulator.

It is only fair to state that the first static control circuit was not designed in record time even with the aid of outside consultation. One reason is that it was necessary for each of the parties to familiarize himself with the other's way of working. It was also necessary to determine the best method of attacking the problem—whether from "scratch" or by conversion of the conventional relay control circuit to static control. Normally, a fresh approach is quicker, in which basic rules of circuit design are applied: 1. Know the processes to be controlled. 2. Make a sequence analysis. 3. Know the controlling devices. 4. Think in terms of function throughout the design.

In this case, however, it was felt that the time required for the visiting application engineer to become thoroughly familiar with the machine would be prohibitive, so the conversion method was used. This method was time consuming, since each relay used in the existing circuit had to be analyzed to determine the basic machine functions with which it was energized. The signals which the relays furnished to the circuit also had to be analyzed to determine their end results. A relay list was devised to aid in recomposing the circuit in terms of basic machine functions, since these are the signals used for static control.

Typical static control elements which were used in the circuit recomposition are described in TABLE 2. The element names are such that they blend directly into verbal descriptions of circuits. For example, in the conventional relay control partial circuit, *Fig.* 2, the manual clamping function may be described as: "A signal from line 54 *AND* 14*CR* energized *AND* the *Close Clamps* pushbutton actuated *AND* 17*CR NOT* energized." Thus, the various conditions linked by the word *AND* could be combined into a multi-input *AND* element, since all of these inputs would have to be present simultaneously for the circuit to function. The required *NOT*


Clamp
301
42SE
301
341
58SE
338
339
CRJ
41
CRJ
345
Close clamps
CRJ
Sol J
64SE
349
358
CRK
41
CRK
364
Open clamps
CRK
Sol K
KEY TO WIRING NOTATIONS
314
495E
Upper number designates wire number. Lower number designates receptacle number.
Symbol on input wire indicates even number terminal is connected to negative common
330 →
← 326
Numbers identify wires. Arrows show directions of current flows where line represents several wires

signal would have to be one which would exist when the coil of relay 17*CR* was de-energized.

Actually, a number of other machine functions must be completed before line 54 and 14*CR* signals will be effective in producing manual clamping action. These include: For line 54—main drive motor running, head back, taps back, and index bar forward or back; and for energization of relay 14*CR*—locating pins in place. Relay 17*CR*, of course, must be *NOT* energized.

In addition to manual clamping, the circuit of *Fig.* 2 is required to effect clamping when the machine is functioning on automatic cycle. To perform both clamping functions, certain input signals are common to both types of cycles and certain others are peculiar to the operating cycle selected. For this reason, the relay list was arranged in three sections. One section lists the signals required for both automatic and manual clamping functions; another shows the signals peculiar to manual clamping; and the third section covers signals required only in automatic clamping. By a similar procedure, the control circuit for the entire machine was studied and the relay list expanded to cover every function.

▶ Drafting the Control Diagram

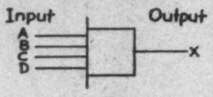
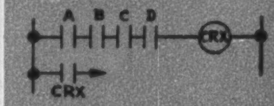
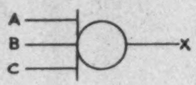
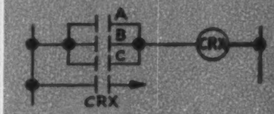
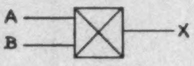
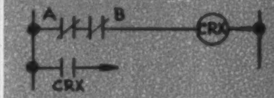
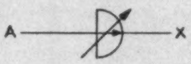
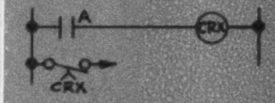
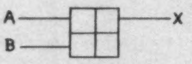
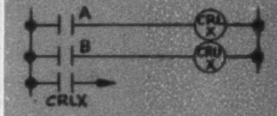
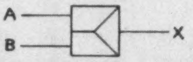
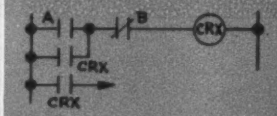
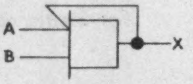
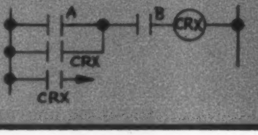
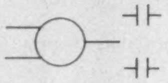
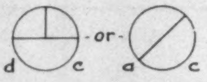
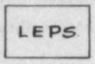
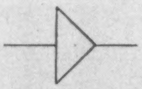
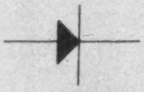
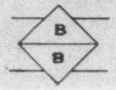
From the functions tabulated in the relay list, an engineer next composed an over-all static control circuit sketch. The sketch was then worked up in diagram form by a draftsman. The portion of the final static control diagram corresponding to the

TABLE 1—Sample Comparison of Engineering and Manufacturing Times for Static and Conventional Relay Control Panels

(Small Automatic Transfer Machine)

Engineering Function	Time Comparison
Circuit Design	25 per cent more time to design static control circuit than conventional relay control circuit.
Panel Layout	About the same panel layout time for static and conventional relay control panels.
Diagram Drafting	10 to 25 per cent more time for diagram drafting with static control than with conventional relay control.
Manufacturing Activity	
Panel Assembly	10 per cent more time for panel assembly with static than with conventional relay control.
Wiring	25 per cent more time for wiring static control panel than for conventional relay control panel.
Testing	About the same testing time required for static and conventional relay control panels.

TABLE 2—Some Terms and Symbols Used in Static Control

Logic Function	Description of Function	Static Control Symbol	Conventional Relay Circuit Equivalent
4-input *AND*	Output obtained only when all four inputs (*A*,*B*,*C*, and *D*) are present.		
3-input *OR*	Output obtained when input *A* or *B* or *C*, or combinations thereof, are present.		
2-input *NOT*	Output obtained only when no input signal is present. Application of input *A* or *B*, or both, will result in no output.		
Time Delay	An input signal will produce an output a predetermined time after application of the input signal. Output will continue until the input signal is removed.		
Retentive Memory	Output, produced when input *A* is applied, will continue even if input *A* is subsequently removed. Momentary or continuous application of input *B* removes output. If power fails or is removed and then restored, system is restored to state it was in at moment of removal of power.		
Release Memory	Functioning is similar to that of Retentive Memory, except system remains in no-output state when power is interrupted and then restored.		
Sealed *AND*	Momentary application of input *A* provides sustained output. Output ceases if power is interrupted or if input *B* is removed or lost.		
Component or Device			
Output Relay	Symbol represents conventional magnetic relay when operated by static control logic elements.		
Original Input (Signal Converter)	A device which adapts an input signal to the proper power level to operate logic elements.		
Logic Element Power Supply	A device which converts 115v ac, 60 cps, into the necessary voltages and currents to properly operate logic elements in their prescribed manner.		
Amplifier	May be a static magnetic device which uses a low-level input to control a higher level output circuit.		
Rectifier	A device which conducts in a unidirectional manner. Generally used to convert ac to dc. A rectifier circuit may include one or more diodes.		
Buffer Unit	A device used to increase the number of logic elements that may be driven from another single logic element.		

conventional relay control circuit of *Fig.* 2 is shown in *Fig.* 3.

Considerable care should be given to the arrangement of the logic element symbols on a diagram and to the sequence numbering of the wiring. This will result in an easily followed diagram which will save considerable panel wiring time and materials by permitting use of the shortest possible wires. Because of the resulting ease of circuit tracing on the diagram, the customer's service men can also perform their duties with a minimum of lost time.

Considering the fact that the system was new to the draftsman, the time required to transcribe the engineer's circuit sketches into final form was not excessive. Use of symbol stamps or templates would reduce this time.

Any wiring diagram should present a clear, concise picture of the control system it represents, and a static control diagram is no exception. In general, the magnetic portions of the diagram should follow established practices such as those contained in JIC and NMTBA standards. The logic portions should adhere to recommendations such as those of the NEMA Subcommittee on Static Control where feasible.

Panel Layout

The physical layout of magnetic control panels has been fairly well spelled out by existing industry standards. Operator safety and simplified maintenance stressed by these standards apply equally well to panels containing static control components. The requirements for power and control segregation, wire color coding, and device identification apply to any control panel, regardless of control medium.

The static control panel designed for this machine is shown in *Fig.* 4. Established practices were adhered to as far as possible. The power and control segregation is clearly defined, the control wires are color coded for ease in tracing, and the devices—including the logic elements—are identified. The three enclosed units on the right are the logic system power supplies. The relays immediately below the power supplies operate infrequently to set up circuits such as *Hand*, *Auto*, and *Lube*. The logic elements and the output relays are on the left. Clip-on covers not only secure the elements in place, but also serve as built-in wire trough. Monitor lamps are visible through the cover apertures.

The bottom row in the logic element section contains the output relays which operate directly from the outputs of the logic elements and in turn energize solenoids. These relays mount in the same kind of receptacle used for the logic elements, hence they can be mounted in the same row with logic elements. The grouping used in this instance is for rapid identification and servicing convenience. The compactness of the output relays and their flexible mounting conserve considerable panel space.

One may question the use of relays in a high reliability control system. Their use for this application was decided purely on the basis of economics. Equivalent magnetic amplifiers would have cost considerably more, and would have consumed vastly more panel area. The output relays, on the other hand, offer life expectancy equivalent to that of a good quality machine tool relay with the added advantage of ease of replacement. Hence, it was felt that the basic system reliability was retained. The panel space required for all the static control components and the infrequently used machine tool relays is less than 65 per cent of that required for an equivalent relay panel.

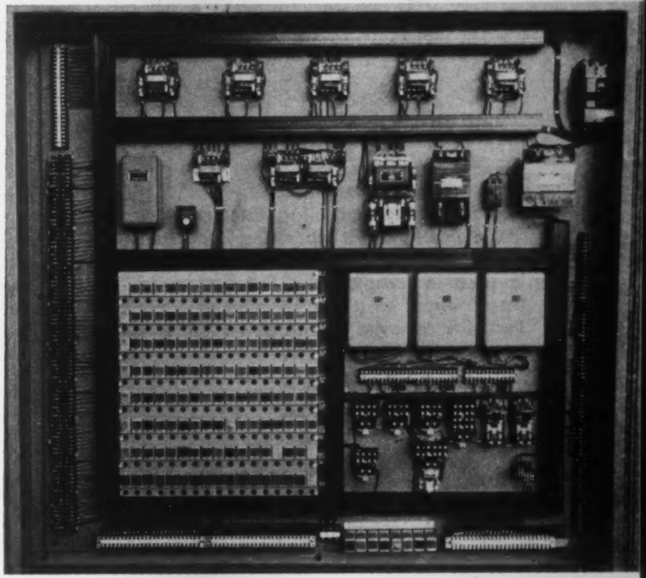


Fig. 4—Close-up of static control panel illustrates grouping of logic elements at lower left. These elements, and output relays in bottom row of group, are plug-in type for ease of replacement. Three enclosed units at right are logic element power supplies.

Panel Assembly and Wiring

Assembly time for the static control panel was about 10 per cent longer than for the equivalent relay control panel. The static control components utilize simplified mounting where possible. All devices, receptacle assemblies, spring clips for covers, and power supplies are mounted with #10-32 screws. The power supplies have plug-in cables for simplified servicing.

Relatively small-diameter wire, of the type allowed in industry standards for low-power electronic controls, is used in the wiring for the static control elements. Although the latter components are not mentioned specifically in present standards covering allowable wire sizes, wire no smaller than #20

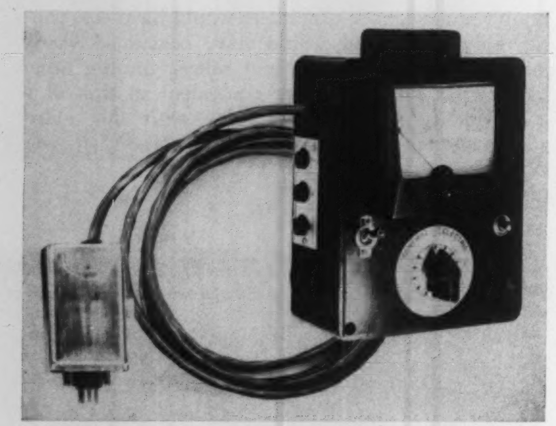


Fig. 5—Test instrument facilitates checking of static control elements under operating conditions. In use, element to be checked is removed from control panel and inserted in receptacle of test instrument. Test plug is then inserted in panel receptacle in place of element that was removed. With power on, element input and output conditions can be checked.

AWG can safely handle the voltage and power requirements of static control elements. The ease of handling of this type of wire greatly facilitated wiring of the control panel.

Control Panel Testing

Testing or checkout of a control panel is necessary at the time the panel is installed and during service periods when malfunctions occur. Ordinarily, conventional control panels are wire-checked only for unwanted short circuits and grounds before they are connected to the machines they control. This is possible because of the ability of most experienced wiremen to correctly wire these panels so that they are at least 98 per cent correct. This procedure is also sufficient for static control panels.

A preliminary check of the magnetic power wiring and the connections from the power supplies to the receptacle rows will enable the panel to be energized once the logic elements have been inserted. All elements must be in place to complete the bias circuit, since their bias windings are connected in series. Thus, if an element is missing, or the bias winding of any element should fail, the system will be inoperative. This fail-safe provision is necessary to prevent false operation of the control system which could damage the machine and possibly injure personnel.

Over-all checkout of the static control panel was accomplished in about the same time as would be required for a relay control panel. Included in the time for the static control panel checkout was the time which the GE application engineer spent in demonstrating system adjustment and troubleshooting techniques.

Monitor lamps associated with the static control elements indicate the states of these elements at all times. The small monitor lamps used are neon type which glow when their respective elements are delivering outputs and are extinguished when no element outputs are present. In addition to showing the operating states of the static control elements, the lamps can reveal failures of common circuits and broken connections between elements. A comparison of the state of the machine, the condition of the lamps, and the normal action indicated by the circuit diagram offers a convenient way of pinpointing circuit malfunctions.

A test instrument, *Fig.* 5, was devised to facilitate checking of the static control elements. In testing, a questionable element is unplugged from the panel and inserted in a receptacle in the instrument. A test plug connected by a cable to the instrument is then placed in the empty receptacle in the panel. The test plug and cable serve merely to bring out all 12 terminals of the panel receptacle to the test instrument. By turning a selector switch on the instrument, each input and its output level can be checked with power applied. System bias and element output can also be measured. The combination of monitor lamps and the test instrument enable rapid servicing of the static control portion of the panel even by relatively inexperienced personnel.

Occasionally it becomes necessary to alter the circuit of a control panel after it is built. Revisions to static control circuits are relatively easy if spare logic element receptacles have been provided in the original panel layout. Also, since the control windings of the logic elements are series-connected, it is a relatively simple matter to cut into the string and insert or remove a winding.

The most meaningful test of a machine and its control equipment is to observe their actual performance on the factory floor. The ability of a control system to withstand even abnormal operating environments is a true test of its quality. Two attributes of static control elements—the absence of moving parts and their fast response to input commands—make for reliable service operation of these devices. Because of their fast response, the condition of two or more circuits being in the wrong state due to response time lags is less likely than it is for relays.

Conclusion

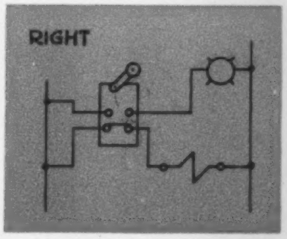
One manufacturer's experience with static control has been described. The findings are similar to those of others who have constructed sizable installations. Lack of experience results in a higher cost for the first static control panel than for an equivalent conventional relay control panel.

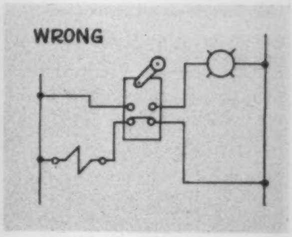
Data supporting the claim of static control to materially reduce downtime and maintenance costs is being gathered. However, the length of time the machine has been in operation is insufficient to permit drawing an accurate performance comparison. To date, performance has been equivalent to that of relay control.

Second of a series, AUTOMATION presents another section of NEMA Publication IC 3-1959, "Precision Snap-Acting Switches." This section contains some of the suggestions for proper application of industrial limit switches covered by NEMA Authorized Engineering Information 1-13-1959, comprising Part 2 of IC 3-1959. The purpose of NEMA Authorized Engineering Information is to provide explanatory data and other engineering information of a character not falling within the classification of a NEMA Standard or Suggested Standard for Future Design.

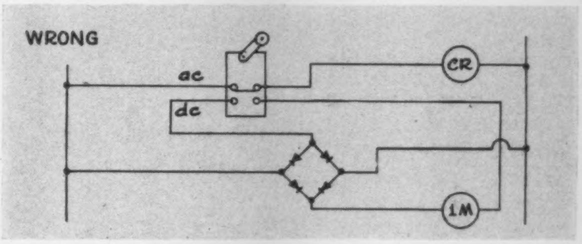
APPLYING INDUSTRIAL LIMIT SWITCHES

IC 3-2.01. Opposite polarities should not be connected to the contacts of one limit switch unless the limit switch is specifically designed for such service.

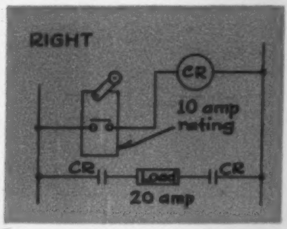


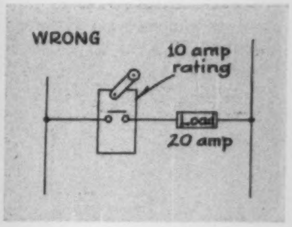


IC 3-2.02. Power from different sources should not be connected to the contacts of one limit switch unless the limit switch is specifically designed for such service.

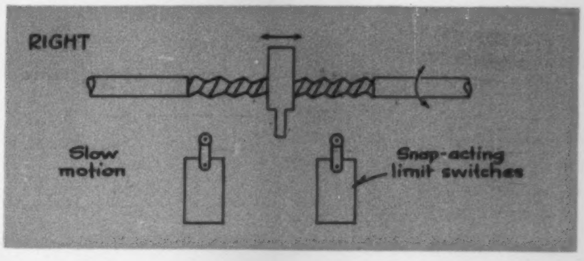

WRONG
ac
dc
CR
1M

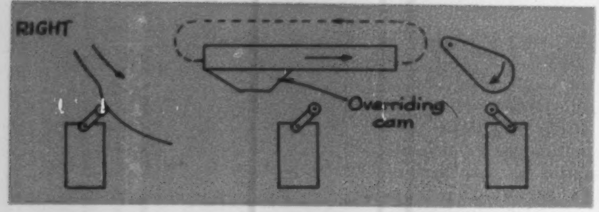
IC 3-2.03. Limit switches should be used within their contact ratings.

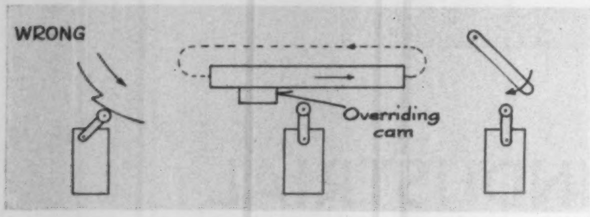

RIGHT
CR
10 amp rating
CR
Load
CR
20 amp


WRONG
10 amp rating
Load
20 amp

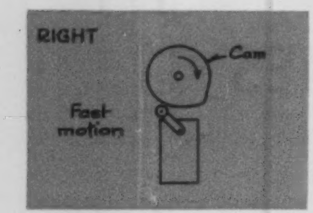
IC 3-2.04. Where relatively slow motions operate the limit switch, it should generally be snap-acting.

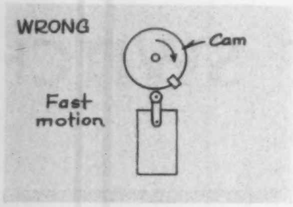

RIGHT
Slow motion
Snap-acting limit switches


RIGHT
Overriding cam

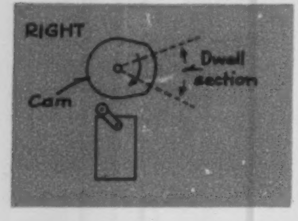

WRONG
Overriding cam

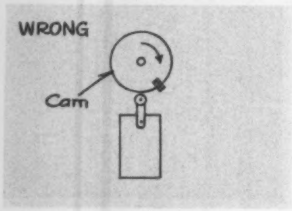
IC 3-2.05. Cam or dog arrangements should be such that the actuator is not suddenly released to snap back freely.


RIGHT
Cam
Fast motion

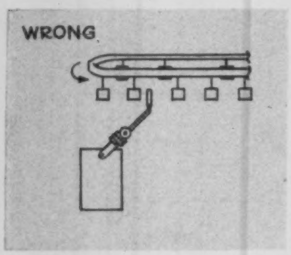

WRONG
Cam
Fast motion

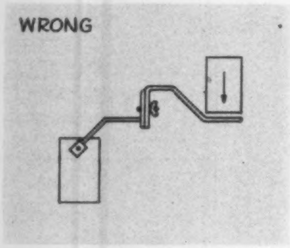
IC 3-2.06. Where relatively fast motions are involved, cam arrangement should be such that the actuator does not receive a severe impact.


RIGHT
Dwell section
Cam

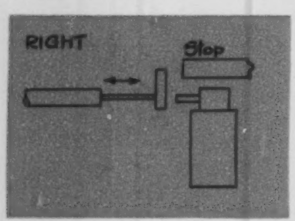


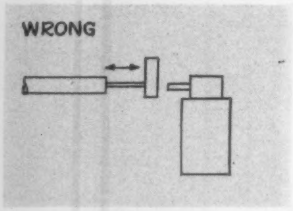
IC 3-2.07. Where relatively fast motions are involved, cams should be designed such that the limit switch will be held operated long enough to operate relays, valves, etc.

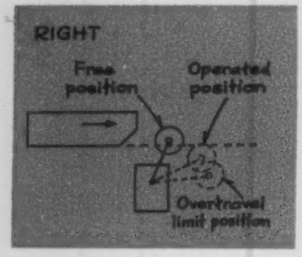


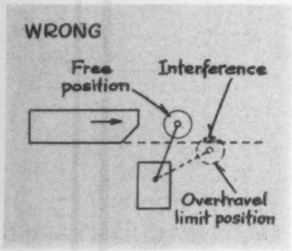


IC 3-2.08. Limit switches are designed for proper performance with the actuators with which they are supplied. Supplementary actuators should not be used unless the limit switches are specifically designed for them.






RIGHT
Free position
Operated position
Overtravel limit position


WRONG
Free position
Interference
Overtravel limit position

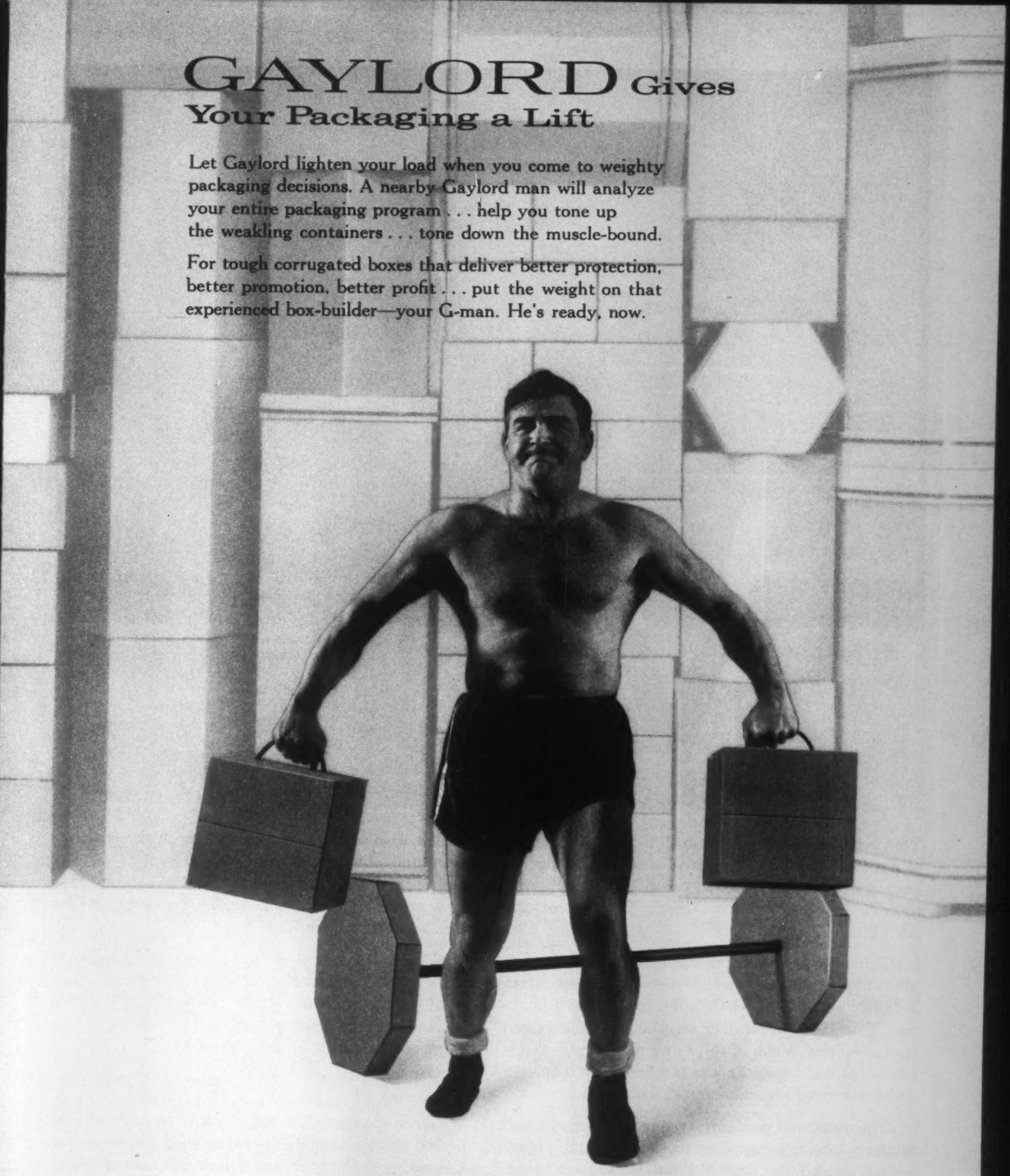
IC 3-2.09. Operating mechanisms for limit switches should be so designed that, under any operating or emergency conditions, the limit switch is not operated beyond its overtravel limit position. A limit switch should not be used as a mechanical stop.

Circle 680 on Page 19→

GAYLORD Gives Your Packaging a Lift

Let Gaylord lighten your load when you come to weighty packaging decisions. A nearby Gaylord man will analyze your entire packaging program . . . help you tone up the weakling containers . . . tone down the muscle-bound.

For tough corrugated boxes that deliver better protection, better promotion, better profit . . . put the weight on that experienced box-builder—your G-man. He's ready, now.



GAYLORD
CONTAINER CORPORATION

Gaylord Boxes

HEADQUARTERS, ST. LOUIS
PLANTS COAST TO COAST

DIVISION OF **Crown Zellerbach Corporation**

A-II
S
V
jco = a0 + a1x

Edwin Felch, project director in charge of developing the Titan guidance system, holds the "voice" of the ICBM.

VOICE
OF A GUIDED MISSILE

This is a missile-borne transmitter. It is the "voice" of a missile in flight . . . part of a new radio-inertial guidance system developed by Bell Telephone Laboratories for the Ballistic Missile Division of the Air Force.

This versatile system helped deliver the nose cone of a Thor-Able test missile precisely to its South Atlantic target area—5000 miles from Cape Canaveral, Florida. So accurately was the nose cone placed that a waiting group of ships and planes retrieved it in a matter of hours. It was the first nose cone ever to be recovered after so long a flight.

The command guidance system which made such accuracy possible combines precision tracking radar with a special Remington Rand Univac computer. Fed a steady stream of signals from the missile-borne transmitter, the ground-based equipment compares the missile's flight path with the preselected path. Corrective steering orders are computed and transmitted automatically to the missile. The ground station monitors the progress of the flight continuously and obtains immediate evaluation of mission success. And since the principal control equipment is kept on the ground, expendable hardware in the missile itself is minimized.

This radio-inertial guidance system is a product of the Bell Laboratories-Western Electric development-production team. It is in production at Western Electric for the first operational squadrons of the Titan intercontinental ballistic missile.

Bell Labs scientists and engineers developed the world's most versatile telephone network and much of our nation's radar. They have constantly pioneered in missile systems. From their storehouse of knowledge and experience comes this new achievement in missile guidance.

BELL TELEPHONE LABORATORIES

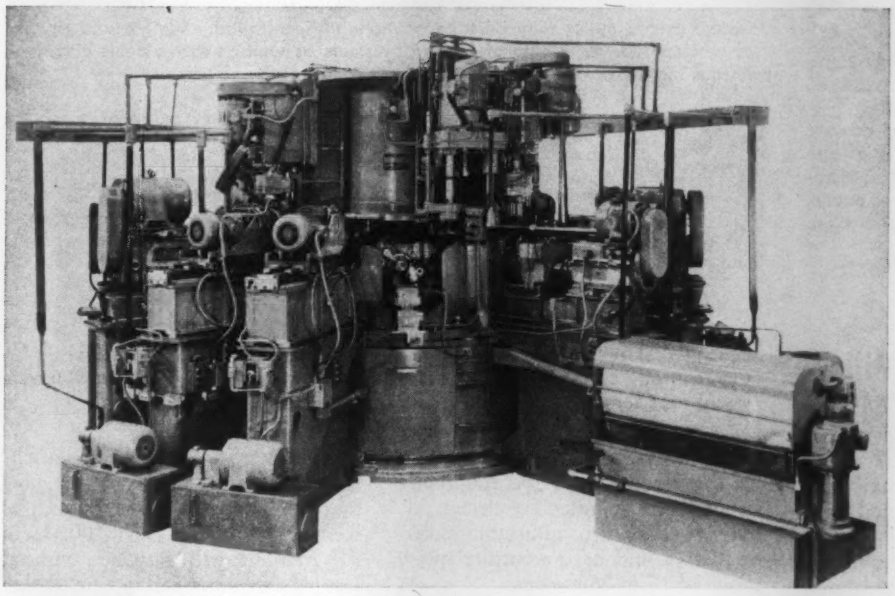
World center of communications research and development

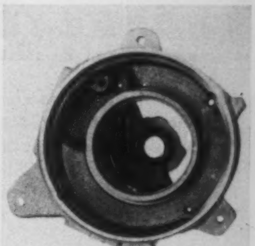
AUTOMATION

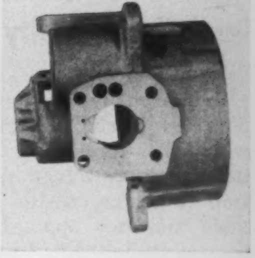
new equipment

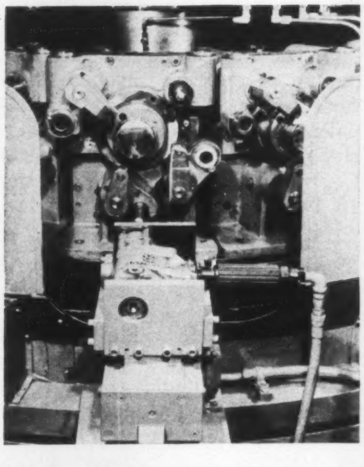
Machines and plant equipment for more automatic operations

For detailed information and literature, use card Page 19.









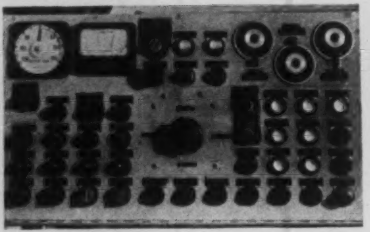
Finish-machined compressor housings are removed from fixtures and replaced with unfinished housings at this station. Parts are located by expanding arbors and held in place with air clamps.

Index Machine Performs 74 Operations

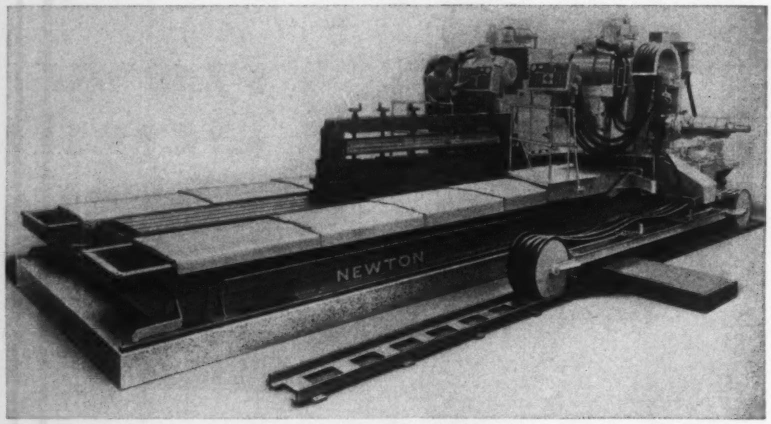
CENTER column machine is capable of automatically performing 74 operations on one-cylinder or two-cylinder refrigerator compressor housings. The 18-station unit (Model 335-S), designed by **Morris Machine Tool Co.,** 2011 Eastern Ave., Cincinnati 2, Ohio, uses an 84-inch diameter hydraulic indexing table. When the table indexes to a dwell position, the individual units perform their operations simultaneously. Drilling, counterboring, spotfacing, boring, reaming, and tapping operations are performed automatically. The only manual functions are loading of unfinished pieces into air-powered clamping fixtures and unloading the completed parts. A single operator performs both of these functions.

Three 8-inch way-type units and 22 drill units accommodate the machine's 74 spindles. All workheads are automatically lubricated either with oil-mist or self-contained lubricating systems. During the finish mill operation, the cutter of the way-type unit raises on the return stroke to eliminate return stroke tool marks. The air-hydraulic drill units have adjustable feed rates, feed strokes, and total strokes. Other drill units provide electrically controlled, mechanically driven drilling and allied operations with torque limiting action. Each drill unit has an independent feed and speed, permitting separate adjustment. Time cycle of the machine is 30 seconds, based on operating a carbide tipped core drill at 100 sfpm and feeding at the rate of 0.032-inch per revolution.

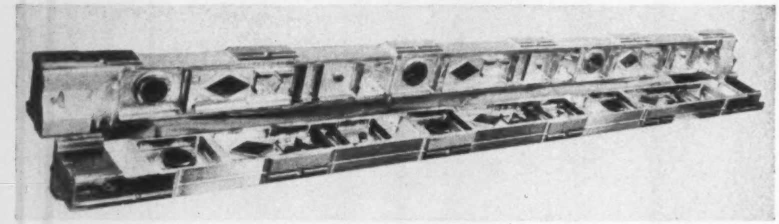
Circle 401 on Page 19



Panel of the machine control console for one milling unit. Magnetic tape transports, reading heads, and associated controls are additional equipment for tape controlled operation.



Duplex cavity miller may be tape or manually controlled. Weight and rigidity of machine permit milling of high alloy steels as well as softer steels and nonferrous metals.



Examples of milled aluminum forgings—squares, diamonds, and circles can be automatically cut on opposite sides of each of the forgings under three-dimensional tape-control.

Dual Head Cavity Miller

Item 402

Equipment is constructed to mill both ferrous and nonferrous metals with either three-dimensional magnetic tape control or manual control. Machine consists of a worktable and two opposed traveling-column milling units. Each column carries a head saddle which travels on a vertical slide. Each head saddle has a horizontal milling head with "in-out" or depth travel. The machine has separate floor-mounted control panels for each side which contain magnetic tape transports and reading heads (the machine can also be furnished with a single milling unit as an openside machine). Telescoping guards are furnished for the bedways, and accordion covers for the vertical ways and the depth screw. The spindles are driven by individual 60 hp, adjustable-speed, dc motors, and have a cutting speed range of 15 to 3600 rpm.

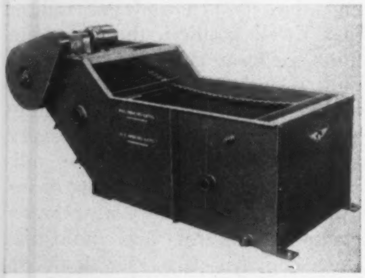
Aluminum forgings can be milled with an accuracy of ±0.0005 to ±0.002-inch, depending on the travel rate. As shown in the illustration, an intricate pattern of squares, diamonds, and circles can be automatically cut on opposite sides of each of the forgings. Sensitivity of the machine is such that it will move 0.001-inch for the first 0.001-inch input motion signal from a differential synchro used in setup orientation. The velocity error constant for all motions in closed servo-loop control is 4 ipm for each 0.001-inch. All motions will respond, without loss of synchronization, to a step input of 30 ipm, providing exponential acceleration and deceleration in one command between zero and 75 ipm. The unit can be furnished as a duplex or openside machine in a variety of specifications for individual requirements. **Consolidated Machine Tool Div., Farrel-Birmingham Co. Inc.,** 565 Blossom Rd., Rochester 10, N. Y.

Circle 402 on Page 19

Magnetic Separator

Item 403

Equipment consists of a tank, magnetic unit, baffle, and sludge scraper mechanism, is capable of automatically removing ferrous solids from cutting oils and water soluble coolants. A magnetic field is provided by shielded alnico permanent magnets suspended below the liquid level. The baffle is placed in a position to direct the flow of dirty liquid through the magnetic field. The sludge scraper mechanism is constructed of a series of stainless steel scraper flights which are mounted on a drag chain conveyor.



The magnetic plate is located at the opposite end of the tank from the inlet to provide a detention period of 4 to 5 minutes. During this interval, heavier solids settle out and sink to the bottom of the tank. The dirty liquid is then drawn through the magnetic field, causing the fines to adhere to the surface of the plate. Clean liquid passes through an aperture in the baffle along piping to the outlets. Dual purpose flights on the conveyor chain continuously remove the solids from the plate and the sludge from the bottom of the tank. As the sludge is dragged slowly up the incline at the end of the tank, it remains above liquid level a sufficient length of time to provide good drainage. Models are available for flow rates ranging from 40 to 1000 gpm. **Industrial Filtration Div., U. S. Hoffman Machinery Corp.,** Dept. LR, Thompson Road Plant #1, Syracuse, N. Y.

Circle 403 on Page 19

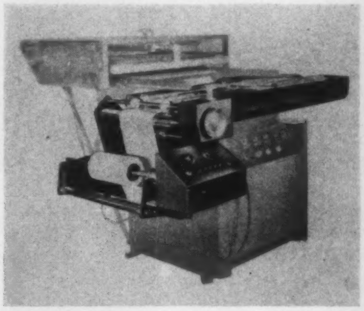
Business Calculator

Item 404

Model IBM 623, an electronic typing calculator with card punch, automatically does the arithmetic on business forms as they are filled out by a typist and punches the results into cards for automatic processing by IBM accounting machines. Unit consists of an electric typewriter, a ten key companion keyboard, a computer unit with a magnetic core storage device, a program reading device, and a card punch.

Instrument can multiply quantity times price and automatically print out the total on an invoice, figure discounts, and compute taxes when directed by a program on a plastic tape inserted in the reading device. The operator selects the information to be punched into cards for further processing in company's accounting systems. The cards do not require any manual preparation or verification. The typewriter in the unit can be used for general typewriting purposes. **Electric Typewriter Div., International Business Machines Corp.,** 590 Madison Ave., New York 22, N. Y.

Circle 404 on Page 19

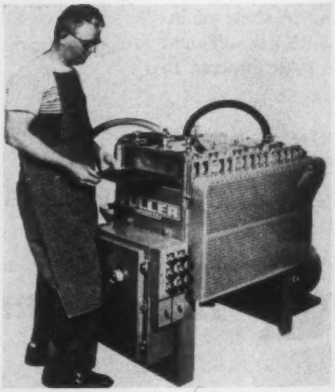


Web Feeding Attachment

Item 405

Attachment is designed to convert standard skin-packaging and vacuum forming machines into automatic blister forming machines. Formed parts come out in a continuous strip ready to be trimmed and packed. The attachment requires no attention as long as film roll is supplied. Maximum draw of the film is 4 inches male or female, or a combination of both. Unit will operate on 220 v, single or three phase, 60 cycle power. **Product Packaging Engineering,** 5713 Joanne Place, Culver City, Calif.

Circle 405 on Page 19

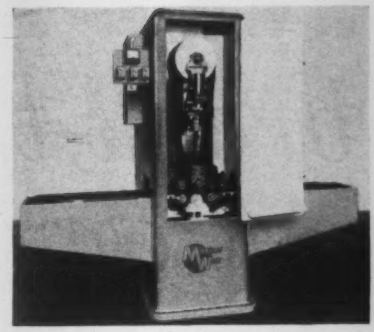


Printed Circuit Scrubber

Item 406

In one operation, machine can scrub, rinse, and dry printed circuits and laminates. The unit will remove all surface dirt and oxides. By a dipping method, it will remove photo-resists after etching. It prepares the plates for soldering and delivers the plates clean and dry. Production rate is 5 to 15 fpm, and machine can accept laminates with 14-inch maximum width and 4-inch minimum length. Pumice slurry is continually circulated through the equipment and is evenly distributed over the entire working area. Brushing action is gentle enough that it will not harm fine printing. The equipment is available in models that will scrub just one side or both sides in one pass. **Machine Div., Fuller Brush Co.,** Hartford, Conn.

Circle 406 on Page 19



Belt Polisher

Item 407

Machine can grind, polish, and deburr flat surfaces of material with cross sections up to 12 by 4 inches. Polisher uses an abrasive belt for either wet or dry operations, can handle material in coils, sheets, bars, or blanks. Manufactured or cast parts can also be processed. Different models are available for feeding the material by conveyor, pinch rolls, or coil-handling equipment.

A feature of the unit is an automatic air control which holds the belt tension and oscillating idler roll pressure constant. Abrasive belts in widths from 6 to 12 inches can be used. A hand wheel on the outside of the machine provides easy adjustment for changes in work thickness. A neoprene contact roll can be dressed in the machine while at operating speeds. **Murray-Way Corp.,** Box 180, Maple Road East, Birmingham, Mich.

Circle 407 on Page 19

PRODUCTION AUTOMATED RIVETING *a major break-through in the Automation of Assembly*

PAR **... Originated by TRS** with the invaluable collaboration of some of industry's top production engineers who sought a major break-through in the automation of assembly operations to reduce costs.

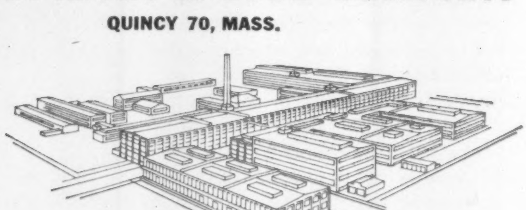
PAR **... A name given by TRS to its Production Automated Riveting process** . . . continuously developed and perfected for 3 years. Proved successful in some of industry's most efficient plants. Now, TRS has sufficient engineers especially trained in the PAR process to serve all manufacturers.

PAR **...It makes riveting practically a new fastening method through efficiently integrated and automatic . . .**

1. **FEEDING** of tubular rivets or related products.
2. **TRANSFER** of parts between riveter stations by means of sliding or rotating fixtures or dial tables. Or through synchronization with conveyors.
3. **SEQUENCING** the operation of from 3 to 15 rivet setters which make all fastenings simultaneously or in any desired sequence.
4. **CONTROL** of setting force as required by parts thickness or material characteristics.
5. **SENSING** of improper conditions and stopping equipment to avoid injury to parts, equipment or operator.
6. **EJECTION** of parts as required.

TRS

TUBULAR RIVET & STUD COMPANY
QUINCY 70, MASS.



Midwest Office & Warehouse in Chicago • SALES OFFICES:
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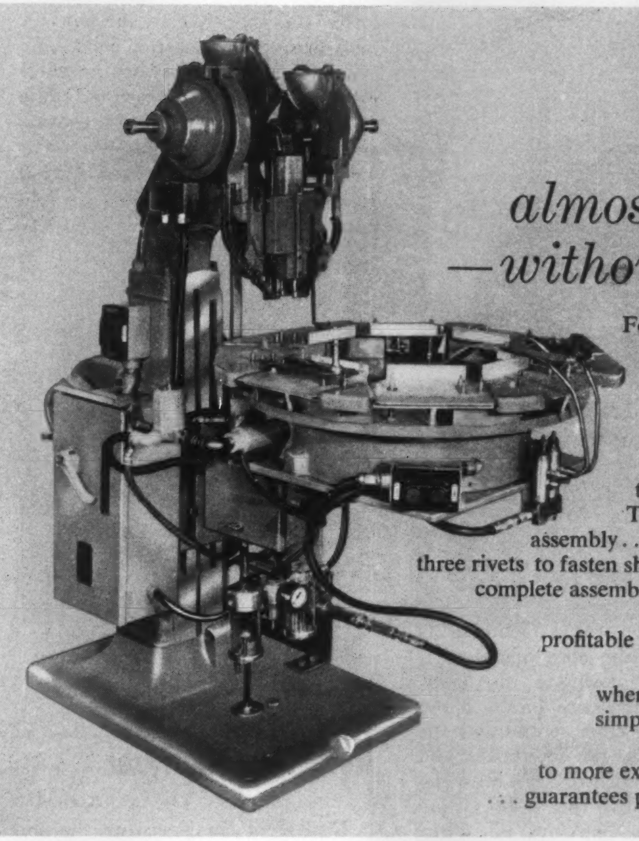


FORD

almost tripled production —without adding to payroll

Ford engineers wanted to step-up the production rate on a window gear and cam assembly. They called in TRS engineers.

Here is the remarkable automatic TRS Machine that resulted. Because center distances would not permit employment of a Multi-Head Riveter, a triple drive machine was adapted by TRS engineers. This eight dial station set-up receives a gear and cam assembly . . . greases it . . . receives a shaft and housing . . . sets three rivets to fasten shaft and housing to the gear and cam unit . . . ejects complete assembly. The machine does everything but load the parts. Ford Motor Company know-how shows in the profitable solution . . . so does TRS ingenuity and experience.

You get the benefit of TRS "recognized ability" when you buy any TRS Riveting Machine . . . from the simplest, standard type to a complicated special design.

TRS offers more machines, to more exactly meet your need . . . will lease but likes to sell . . . guarantees performance and sticks by you with all-out service.

PAR . . . It's a TRS Process for very good reasons!

Obviously, there are two critical elements in the PAR Process. Essential is the special and extensive knowledge and experience needed to design an integrated system of standard or multi-head riveters, feeders, transfers and controls for the particular assembly involved. Equally important are superior knowledge and experience in the design, tooling and application of Multi-Head Riveters because these are usually employed.

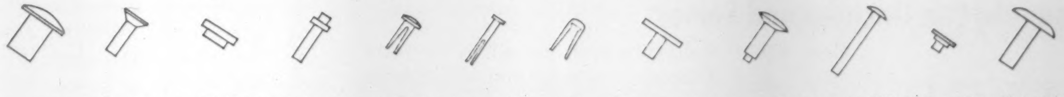
TRS originated Multi-Head Riveters over three years ago and is the only experienced source of these machines. Further, because this TRS development opened up new possibilities for automating the riveting process, TRS was able to begin three years ago to develop the special experience and application engineers required to fully meet the requirements of the PAR Process.

PAR . . . A New Opportunity to Reduce Direct Labor Charges

With this new help, hundreds of manufacturers . . . large and small . . . can effect substantial savings in direct labor charges, increase production rates, decrease parts spoilage and machine down-time. Look into it now if your product can be riveted, and especially if several rivets are involved.

The yearly amortized cost of the TRS Multi-Head Riveter equipment is low because it will not be obsoleted by changes in product design or production line.

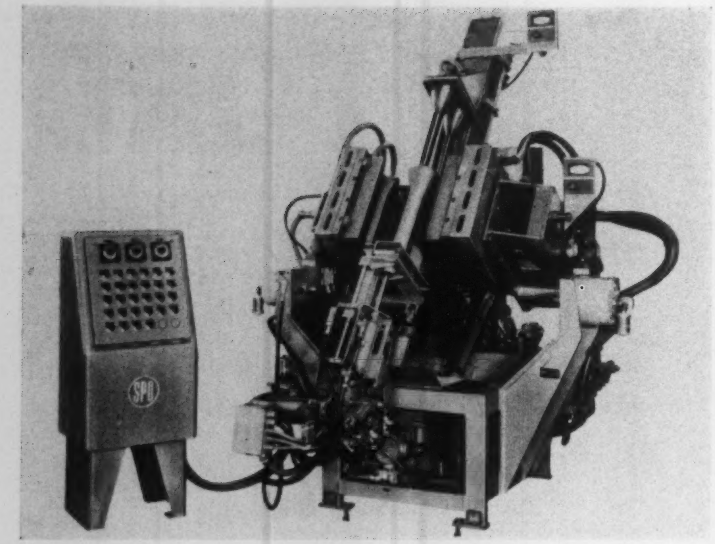
To save more...To protect against equipment obsolesence...don't buy any Riveting Machines until you investigate the PAR Process



You're not required to use TRS Rivets but you'll be better off if you do

There are no contracts or obligations involved in the PAR Process. However, it is true that the more automatic you make your riveting, the more important it is to use rivets that reduce operating troubles and machine down-time. And, we can give you good, factual reasons why TRS Tubular Rivets are more reliable in essential qualities and uniformity. Ask for the facts . . . judge for yourself.

Advt. Copyright by Tubular Rivet & Stud Company, 1958

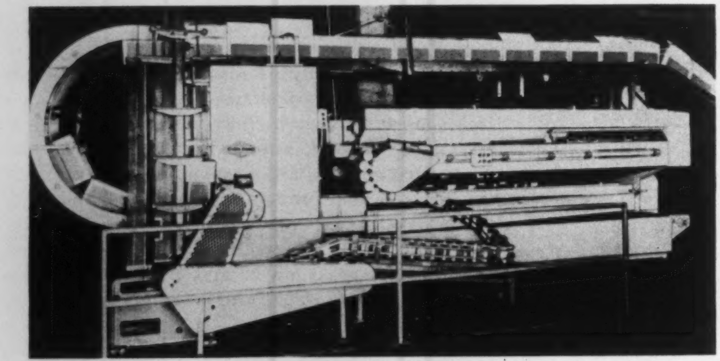


Sand Core Machine Attachment

Item 408

Designed for use on company's single station hollow core machine, attachment provides close control of sand core wall thickness and uniformity of cure. Attachment consists of one or more internally heated mandrels, an operating mechanism, and controls. Each mandrel, heated by a 110 v, 1500 w element, is individually thermostatically controlled. When the attachment is connected to the core machine, it automatically positions the mandrels, closes the core boxes, blows and cures the cores, withdraws the mandrels, opens the core boxes, and deposits the finished cores on a delivery belt. **SPO Inc.**, 6306 Grand Division Ave., Cleveland 25, Ohio.

Circle 408 on Page 19



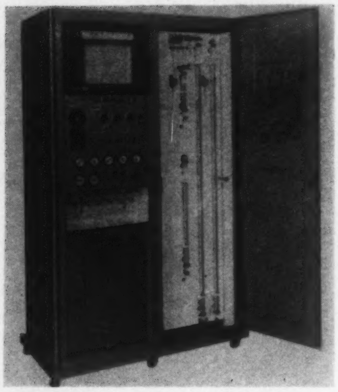
Automatic Can Uncaser and Sorter

Item 409

Equipment can automatically uncase and unscramble cans ranging in size up to 32 ounces. It can also handle any group of can sizes where the smallest can is approximately one inch longer than the diameter of the largest can. A feature of Model CUS12 is a magnetic pulley which turns cans up so that their open ends are all in the same direction, ready for the filling cycle.

In operation, reshipper cartons or shipper trays are inverted in the uncaser and the scrambled cans are fed into the bottom of the can sorter. Oscillating rubber sweeps lay the cans end-to-end in rubber covered flights. These flights lift the aligned cans to the top of the sorter and then release the cans in rows to single-file carrier belts. The cans are then conveyed to the magnetic pulley for final sorting. The magnetic pulley orients the cans and feeds them to a can elevator or directly to a filler conveyor. **Atkron Inc.**, Cuyahoga Falls, Ohio.

Circle 409 on Page 19



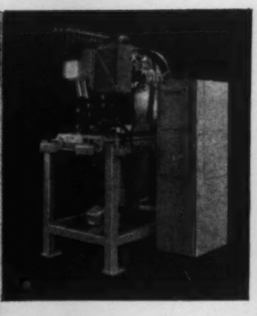
Recording Analyzer

Item 410

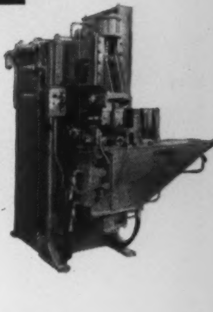
Design of analyzer for the ion exchange chromatography of amino acids and related compounds is based on the Spackman-Stein-Moore system for separation of mixtures of amino acids (including protein hydrolysates, tissue extracts, or biological fluids). Model K-5000 consists of two major parts: The chromatographic equipment and an analyzer unit. The chromatographic equipment includes ion exchange columns packed with classified resin, and adjustable precision pumps for buffer and reagent supply. The ion exchange columns are provided with an adjustable thermostat control which allows automatic temperature changes during an analysis. The precision pumps meter elutrient buffers which can also be changed automatically during the analysis. Mixtures flow into a heated reaction vessel through capillary tubing.

The analyzer unit is made of a flow-photometer assembly and a multipoint recorder. The flow-photometer is designed to detect the absorbance of the continuous effluent stream at the different wavelengths of 440 mu and 570 mu. A precision flow type absorption cell

automatic national electric welders



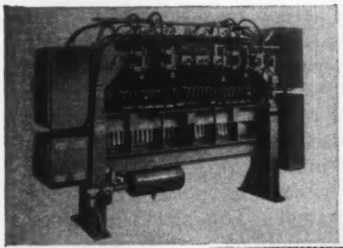
◂ This six gun National Multi-spot Welder spot welds automobile ash tray assemblies at the rate of 650 assemblies per hour. (1 operator).



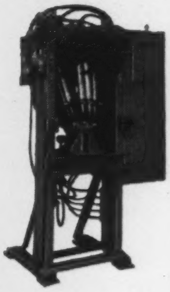
Feeding, forming, mash-seam welding and ejecting of small motor frames is done at the rate of 425 per hour on this National welder. (No operator). ▸

that are giving big production

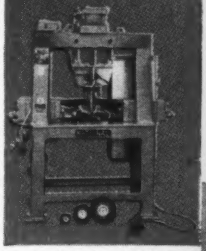
A great variety of individually automated, high-production welding jobs throughout industry are being performed with amazing rapidity by National Electric Welding Machines . . . engineered and built for the job by National Electric. If you have a volume welding operation, an automatic National Electric unit specially designed and built for you can do the job faster and more economically. Here are a few typical examples . . .



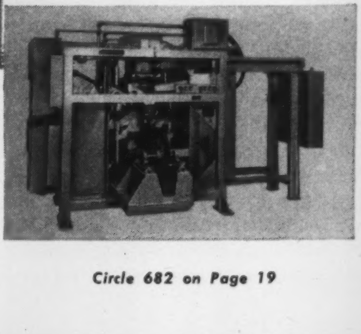
One man operates this 28-gun, air-operated unit that spot welds 300 radiator grille reinforcement assemblies per hour.



▴ One of three identical National Electric machines for locating and spot welding 300 left-hand and right-hand automobile head-light assemblies per hour (on each machine).



▸ This multi-spot unit spot welds 400 wire brush assemblies per hour. Fast change-over from one size to another. (1 operator).



Traveling fixtures locate and carry automobile engine supports past air operated guns at the rate of 600 assemblies per hour on this National unit. 20 welds per assembly. (1 operator). ▸

NATIONAL
Electric
welding machines co.
1870 N. TRUMBULL STREET
BAY CITY, MICHIGAN

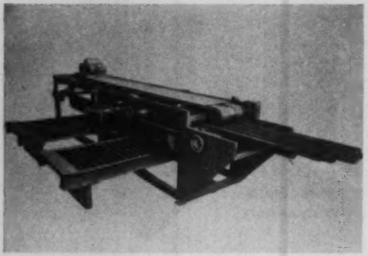
25 YEARS' EXPERIENCE DESIGNING AND BUILDING: SPECIAL & STANDARD • AIR • HYDRAULIC • MOTOR DRIVEN • SPOT • PROJECTION • SEAM • BUTT • FLASH • RESISTANCE WELDERS • PRODUCTION FIXTURES FOR ALL TYPES OF AUTOMATIC ARC WELDING.

57

Circle 682 on Page 19

enables the effective light absorption path of a detector to be shortened, providing a wide range of sensitivity. The multipoint recorder prints three separate absorbance curves in different colors, each color representing the absorbance at a specific wavelength. **Phoenix Precision Instrument Co.,** 3803-05 North 5th St., Philadelphia 40, Pa.

Circle 410 on Page 19



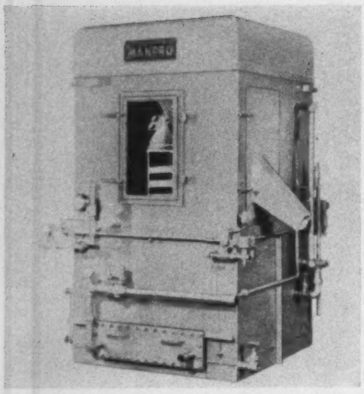
Magnetic Sheet Piler

Item 411

Trapezoids, triangles, parallelograms, and other odd-shaped ferrous sheets can be handled by magnetic sheet piler. Illustration shows the operating side of the conveyor. The sheets enter from the right onto the entry conveyor. The entry conveyor feeds the sheets into the magnetic conveyor which picks them up and sends them forward. Magnets are controlled by proximity switches which are mounted inside the magnetic conveyor. The switches do not touch the sheet. When the front edge of a sheet passes under a pickup head it will energize a group of magnets over the bin to be used. The magnets support the sheet across the bin opening. When the back edge of the sheet passes the pickup head, the magnets are de-energized and the sheet drops into the bin.

When the sheet falls, air is trapped under it to help cushion its fall. An end stop is provided with a rubber pad which is cushioned so the front edge of the sheet cannot be damaged. Machine will stack oiled, dry, or coated sheets at rates of 100 to 300 fpm. Two separate stacks can be made. Stacking can be done in either bin or alternately. Reject sheets are ejected out the far end of the machine. **Bucciconi Engineering Co. Inc.,** 899 Grant St., Gary, Ind.

Circle 411 on Page 19

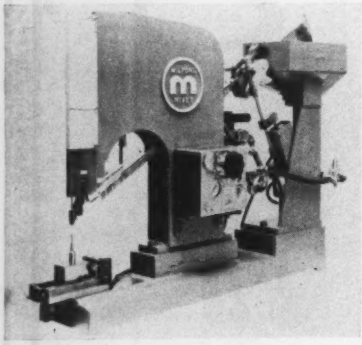


Parts Coating Machine

Item 412

Unit can automatically coat nails on a high-production rate basis. After a cleaning operation, the nails automatically enter the coater where they are coated and dried while they travel 54 ft up a spiral elevator to a 4 x 5 ft tank. Nails are separated for drying so they will not stick when packed. Machine can also be used for coating or painting other small parts. **Manpro Corp.,** 1454 Hilton Rd., Detroit 20, Mich.

Circle 412 on Page 19

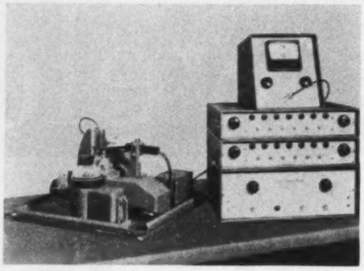


Pneumatic Riveter

Item 413

Pneumatic riveter features a blade hopper attachment which permits straight in-line feeding of parts such as long tubular rivets, collar studs, and threaded or knurled parts. Model 56-BH can also be used in conjunction with fixed position setting tools, in-line slide fixtures, or rotary tables. A pneumatic cylinder drives the setting tool through a toggle linkage; another air cylinder drives the blade hopper—both drives operate from a single air and lubricating control with shop air from 60 to 150 psi. The hopper system can be continuously cycled or intermittently operated. Throat depth of the machine is 9 inches; stroke is 2 inches. When equipped with a fixed position tool the maximum rivet length capacity is $^3/_4$-inch; when equipped with slide fixtures the maximum capacity is approximately $1^1/_2$-inch. **Milford Rivet & Machine Co.,** Milford, Conn.

Circle 413 on Page 19

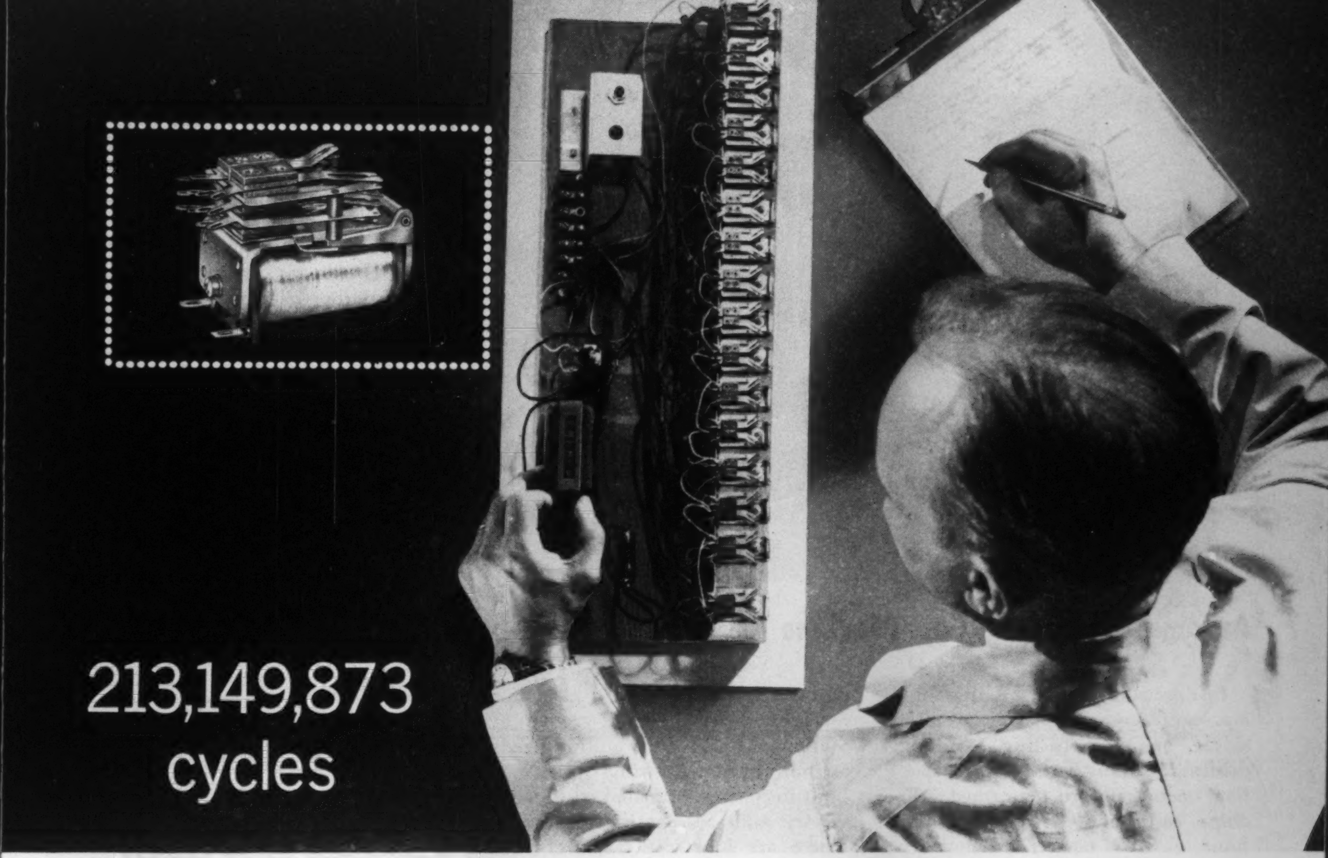


Gaging/Sorting Device

Item 414

System automatically measures and sorts small, delicate parts such as semiconductor wafers on the basis of thickness. In operation, wafers are gently fed from a rotary vibratory feeder to a linear feeder. As they travel along the linear feeder, the parts are positioned in single file. At the end of this feeder they pass a set of vacuum holes. When the leading wafer passes the vacuum holes it interrupts a photoelectric circuit and moves onto the gaging anvil. This action energizes a vacuum *Hold* circuit, which prevents all other parts on the feeder from moving across the photocell opening. It also initiates a gaging cycle for the particular wafer on the anvil. All wafers are electronically classified and physically sorted into one of 13 grades of thickness. Machine can handle approximately 3600 wafers per hour. Wafers range in size from 0.040 x 0.040 x 0.0015-inch to 0.190 x 0.190 x 0.010-inch. **Airborne Instruments Laboratory, Div., Cutler-Hammer Inc.,** 160 Old Country Rd., Mineola, N. Y.

Circle 414 on Page 19



Test proves reliability of P&B's LS telephone type relay

These 16 LS relays, wired into a self-cycling chain, each operated 213,149,873 times before the test was discontinued. This test was made for a nationally prominent manufacturer and the certified results are available upon request.

Here is proof of the inherent reliability of P&B telephone type relays . . . and of the kind of performance you can expect when you specify them. LS relays are available with up to 20 springs (10 per stack) and are adaptable for printed circuit mounting.

Whenever multiple switching of loads up to 4 amperes is required, the LS can usually meet space, weight and—importantly—price considerations. Get full information today by calling or writing Zeke R. Smith, vice president, Engineering, or contact your nearest P&B representative.

LS ENGINEERING DATA

GENERAL:

Breakdown Voltage: 1,000 volts rms 60 cy. min. between all elements.
Ambient Temperature: —55° to +85° C.
Weight: 3 to 4 oz.
Dimensions: 1$\frac{5}{32}$" W. x 2$\frac{3}{8}$" L. x 1$\frac{1}{2}$" H. (4 Form C)
Enclosures: Sealed or dust cover (W can) Sealed or dust cover, up to 6 Form C, single contacts (D can)
Mountings: Four #6-32 tapped holes $\frac{3}{4}$" x $\frac{5}{16}$" o.c. Other mountings available.

CONTACTS:

Arrangements: 20 springs (10 per stack) max.
Material: $\frac{1}{16}$" dia. twin palladium. Other materials available for specific applications.
Load: 4 amps @ 115 volts 60 cy. resistive.

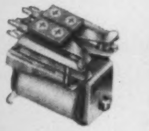
COIL:

Resistance: 55,000 ohms max.
Power: 65 mw DC per movable standard (50 mw possible); 3.5 watts max. at 25° C.
Voltage: Up to 200 volts DC.

TERMINALS:

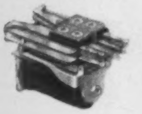
Contacts: Three #18 AWG wires.
Coil: Three #20 AWG wires.
Available with octal plug, taper tabs or printed circuit pins.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



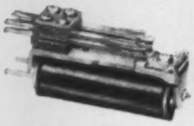
TS RELAY

Short coil relay is available in AC and DC versions. Long life construction. Can be supplied (DC) with up to 20 springs (10 per stack).



GS RELAY

Excellent sensitivity: 50 mw per movable arm minimum (DC). For applications requiring many switching elements in small space.



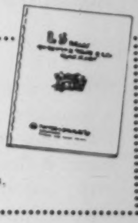
BS RELAY

Long coil provides high sensitivity (25 mw per movable arm) and room for slugs for pull-in delays (150 milliseconds max.) or drop-out delays (600 milliseconds max.).

FREE

LS DETERMINATION DATA

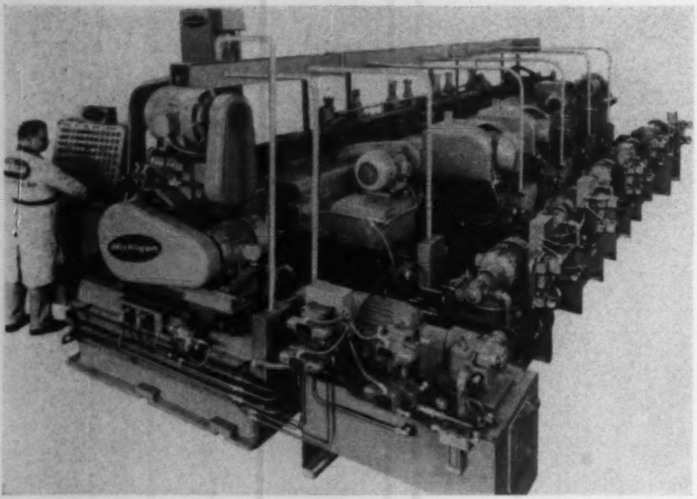
Send today for booklet containing certified results of recent test described above. Data includes test circuit, interim and final measurements.



POTTER & BRUMFIELD

DIVISION OF AMERICAN MACHINE & FOUNDRY COMPANY, PRINCETON, INDIANA
IN CANADA: POTTER & BRUMFIELD CANADA LTD., GUELPH, ONTARIO

Circle 683 on Page 19

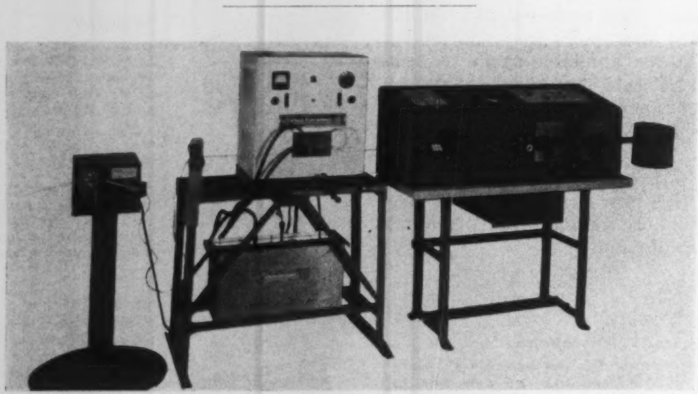


Automatic Bearing Cap Machine

Item 415

In-line transfer unit produces five automotive bearing caps from a single, one-piece casting. Milling, drilling, reaming, cutoff, and inspection operations are performed. Machine can handle 75 castings per hour at 100 per cent efficiency. Each working station of the 19-station, horizontal and vertical unit is designed for individual cycling. Features of the machine include: A heavy-duty planetary head for machining an oil seal groove at Station 1; heavy-duty milling heads at milling and sawing station; a built-in power operated chip conveyor; and automatic lubrication. There are four idle stations available for retooling purposes. **Michigan Special Machine Co.,** P. O. Box 4643, Detroit 34, Mich.

Circle 415 on Page 19

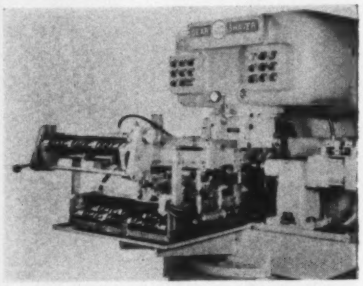


Induction Tinning Machine for Stranded Wire

Item 416

Process automatically feeds tinned, stranded hook-up wire from a standard reel or spool through an induction heating coil. The equipment is designed for operation with any automatic or semiautomatic wire stripper. The setup automatically senses the spots along a continuous length of wire where stripping of the wire will occur. At these spots, short pulses of radio frequency energy are applied as the wire travels towards the stripper. This energy induces electric currents at the preselected spots, causing a high amount of heat. The heat melts and reflows the tinning on the individual strands, soldering the wire into a solid bundle which will not fray after the strain of cutting and stripping. The length and location of the reflow area is laid out so that the wire is cut and stripped in the center of each spot, providing two solidly retinned ends. The range of wire lengths that can be handled is controlled by the maximum and minimum lengths that the stripper will handle. The length of an individual heated area along the wire is controlled by the configuration of the induction coil. **Reeve Electronics Inc.,** 609 W. Lake St., Chicago 6, Ill.

Circle 416 on Page 19



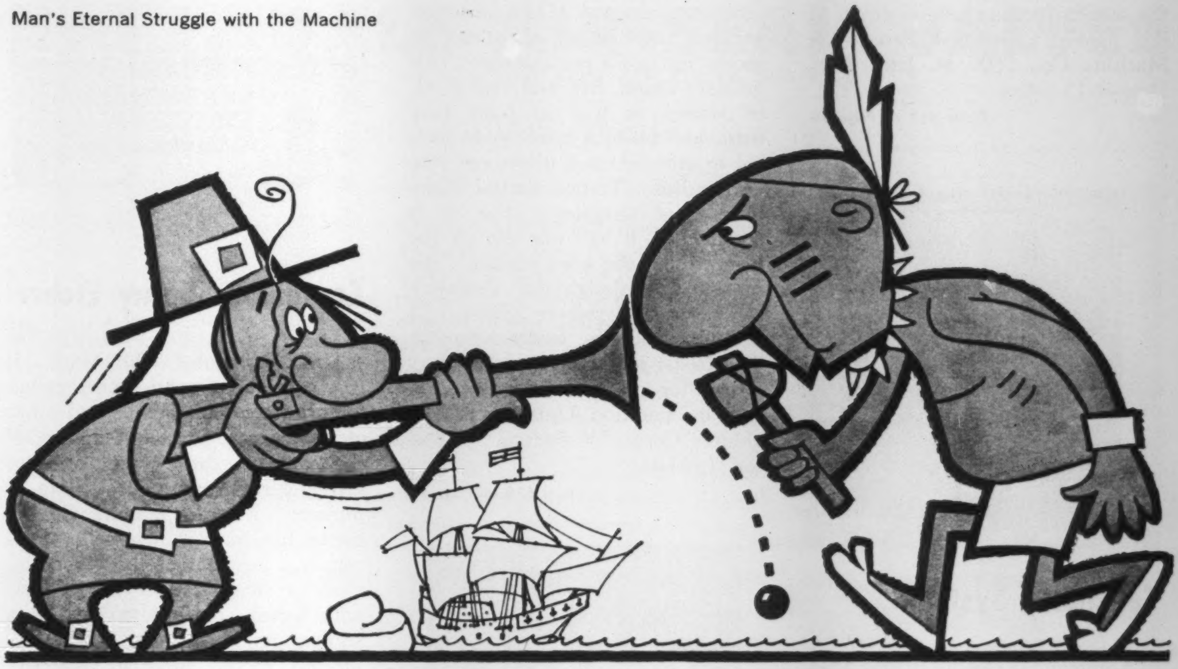
Automatic Parts Loader

Item 417

Designed for handling long, slender parts on gear shaving or gear honing machines, automatic loader features an air-cushioned exit motion and an air-powered steady rest. Parts such as automotive camshafts having gears at one end are loaded into a magazine in the loader and pass a pair of gaging master gears to check for any oversize condition of the gear to be shaved or honed. In the magazine, the parts are spaced apart by a series of linkages that automatically advance the supply each time a part is removed and fed into mesh with the cutter or honing tool for the finishing operation.

Air-powered head and tailstocks advance centers into each end of the shaft in the meshing position. When a part is in finishing position in mesh with the gear-shaped tool, an air-powered steady rest is raised to contact one of the bearings in the middle of the camshaft. The steady rest is raised to a positive stop and locked in position while the gear teeth are being finished. When the operation is completed, the steady rest lowers and an air-cushioned mechanism lowers

Man's Eternal Struggle with the Machine



RISING COSTS AND SHRINKING PROFITS EXERT UNUSUAL PRESSURES ON PROCUREMENT

What is the risk of letting conditions tempt you to select the lowest bid?

You're in a tough spot to say the least!

Because if you care at all about *your* future or your company's profits, you take every precaution to make sure that "real deal" price tag is hanging on a machine that *will* do your job.

Obviously, price alone is indicative of nothing more than the bidder's determination of cost, plus the profit any manufacturer must earn to remain in business—nothing more—no true suggestion of value . . . and, of course, never even a hint of equipment suitability to *your* needs.

Unfortunately, the lowest bid often results from price cutting under competitive pressures. And price cutting *necessarily* down grades equipment value—unless the price-cutter is in business for reasons other than making a profit!

Sciaky resistance welding and production equipment *must* satisfy *your* manufacturing requirements. And Sciaky manufacturing operations must earn a profit just as your company must. That's why Sciaky *first* determines what *will* satisfy your requirements, and then figures the cost of putting it to work for you.

Why take less than the full advantage of consulting with a Sciaky Application Engineer the next time you are considering equipment. No obligation, of course.

Recently a procurement official boasted of his subterfuge to reduce costs . . . "tell every vendor his bid is way out of line, and you can brow-beat them into substantial price reductions." Besides the question of ethics, he's cheating his company of its ability to manufacture profitably, as well. Because no vendor can deliver more than he gets paid for—that is, not if he intends to stay in business. When that official's manufacturing operations begin to sag under the dead weight of phony equipment bargains, who do you suppose is going to be holding the proverbial bag?

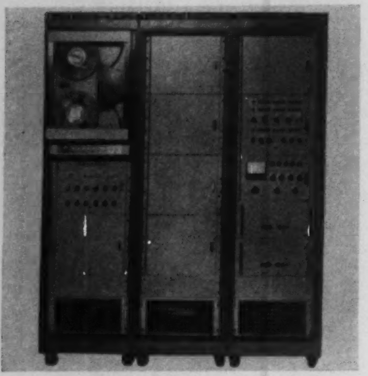
SCIAKY®

70A

SCIAKY BROS., INC., 4942 W. 67th STREET, CHICAGO 38, ILLINOIS • POrtsmouth 7-5600

the camshaft into the exit chute of the loader. **National Broach & Machine Co.**, 5600 St. Jean Ave., Detroit 13, Mich.

Circle 417 on Page 19

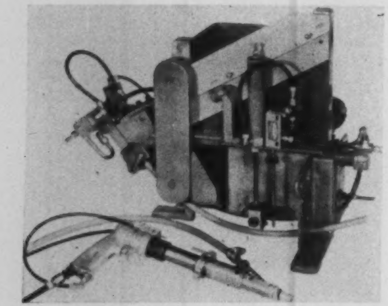


Telemetry System

Item 418

Automatic PDM-to digital computer format telemetry data system is capable of receiving flight test data either directly or from an analog tape. It converts the data into digital form, and records the data on a magnetic tape. Modular system can operate without calibration or adjustments with an accuracy of better than ±0.1 per cent. Features of the unit include: Arbitrary selection of data records and mode of operation associated with the PDM frame rate. **Epsco Inc.**, 588 Commonwealth Ave., Boston 15, Mass.

Circle 418 on Page 19

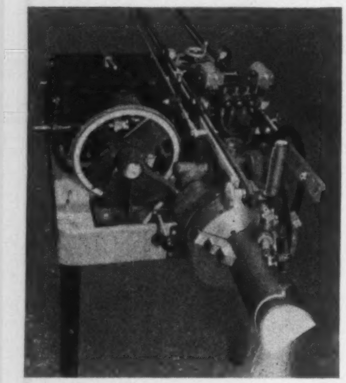


Power Screwdriver

Item 419

All wood screws ranging in size from ½ to 1¾-inch, in gages from 6-10, can be handled by automatic power screwdriver. A total of 26 different sizes and types of screws can be automatically fed and driven without any change of fittings, at speeds up to 60 per minute. This includes round, flat, and oval headed screws, as well as some pan, truss, and binding head types. Slotted or cross-recessed drives can also be handled. Torque control eliminates head stripping. The bit is designed so it will not slip off the head to mar the work surface. The screwdriver, designated Powasert, can be used anywhere within a 21 ft radius of the feeder-separator. The feeder-separator holds 10 lb of screws for up to 8 hours of continuous operation. **United Shoe Machinery Corp.**, 140 Federal St., Boston 7, Mass.

Circle 419 on Page 19

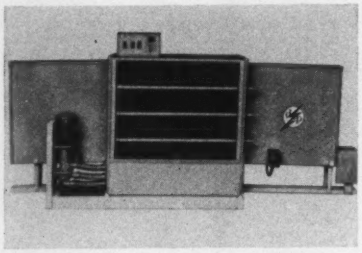


Contour Cutter

Item 420

Automatic unit can flame-cut pipes at a rate of 20 ipm (a 6-inch aluminum pipe can be contoured in 20 seconds). In operation, the pipe is clamped into a 3-jaw chuck and the necessary data are fed into a control mechanism. A pushbutton initiates the action, in which no templates, layouts, or patterns are required. Sections of pipe requiring straight, mitered, or contoured ends can be prepared with proper bevels for welding. Cutting head of the machine is equipped with an oxyacetylene torch for cutting carbon steel, or a Linde Co. Heliarc unit for cutting aluminum, stainless steel, copper, cast iron, magnesium, and high alloy steels. Different styles of the cutter can handle pipe from 2 to 24 inches in diameter. **Steffan Mfg. Corp.**, 276 S. Lincoln St., Salem, Ohio.

Circle 420 on Page 19

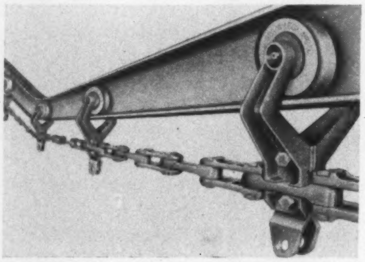


Continuous Spray Etcher

Item 421

Unit, designated DSP Mark 11, is a continuous nozzle spray etcher for printed circuit boards and other etched metal products. Speed of the conveyor can be controlled to give etching exposures from 1 to 20 minutes. Machine can handle 120 linear fpm of 25 inch wide, 1 oz copper. Features of the etcher include a steel channel base coated with baked vinyl protective finish, sealless pumps, and use of titanium for all metal parts in corrosive areas. Etcher also has a switch interlock on the conveyor to prevent work spoilage if an operator does not remove the finished work from the delivery tray, and an interlock to break the spray pump motor circuit in the event that the service door is open. **Dry Screen Process Inc.**, 1016 Madison Ave., Pittsburgh 12, Pa.

Circle 421 on Page 19



Overhead Chain Conveyor

Item 422

Suitable for light or heavy loads and towing applications, overhead chain conveyor system is constructed of a rivetless type endless chain supported by load carrying trolleys which roll on the lower flanges of a 4-inch I-beam type track. The chain is mechanically propelled and is supported at all horizontal turns by a series of rollers or wheels while the track absorbs the thrust or ver

BARKSDALE AIR-SEAL* VALVES

LOW PRESSURE AIR TO 250 P.S.I.

. . . over 200 different valves available.

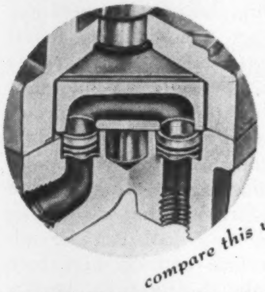
**The air pressure is the sealing force . . . the higher the pressure, the tighter the seal.*

Why so many different air valves?

Because air valve requirements vary with the method of actuation. A basic valve with interchangeable actuators cannot possibly meet ALL your specific applications without compromise. For example: A solenoid valve designed for speed would not have the stamina required of a manual or foot valve.

The Barksdale line of AIR-SEAL Valves has been designed with your requirements in mind. All our valves have been engineered for best performance from your point of view . . . for YOUR specific need, and not to make OUR job easier.

MANUAL and FOOT OPERATED "SHEAR-SEAL" VALVES



No oilers and filters needed — not critical to dirt and corrosion — made from non-corrosive materials.

Years of leakproof service — without constant maintenance — Self aligning "Shear-Seal" design compensates for normal wear.

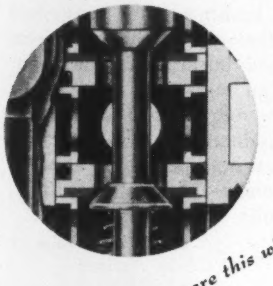
compare this with conventional

SPOOL or PLATE VALVES

Alignment is critical — dirt and corrosion cause sticking.

There is no compensation for normal wear — leakage increases with use.

SOLENOID-PILOT CRESCENT® (Self-aligning poppet) VALVES



Quick response (12 milliseconds) due to short travel of poppets and solenoid.

Tight sealing — self-aligning, self-scavenging design adjusts to normal wear — not critical to dirt and corrosion—non-corrosive materials throughout.

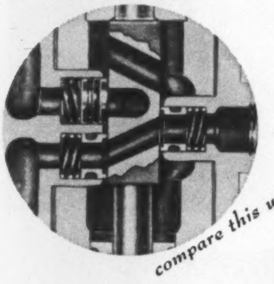
No coil burnout — heat dissipating "integral" design.

compare this with conventional

SPOOL VALVES

Slower response due to long spool travel. Leakage increases with use — dirt and corrosion particles are ground-in between spool and seals—Sticking! Overheating causes coil burnout — poor heat transfer of "unitized" design.

DIRECT-SOLENOID OPERATED "SHEAR-SEAL" VALVES



Leakproof for years of service — self-adjusting to wear.

No coil burnout — because valve does not freeze up.

compare this with conventional

SPOOL VALVES

Dirt enters spool clearances — develops leaks — causes sticking — sticky valves are to blame for most solenoid burnout.

Write for Air Valve Catalog 9-AV

CONTROL VALVE DIVISION

barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

MANUALLY OPERATED

4-Way valves
1/4 to 1 1/2" N.P.T.
with or without
spring return

Shut-off valves
1/4 to 1" N.P.T.
with or without
spring return

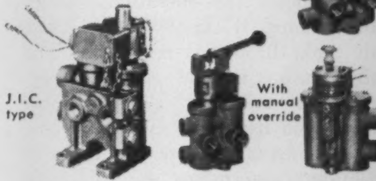
FOOT OPERATED

4-Way valves
1/4, 3/8 and 1/2" N.P.T.
with or without
spring return

SOLENOID-PILOT

4-Way valves
1/4 to 3/4" N.P.T.
A.C. and D.C.
Standard

Explosion-proof



J.I.C. type

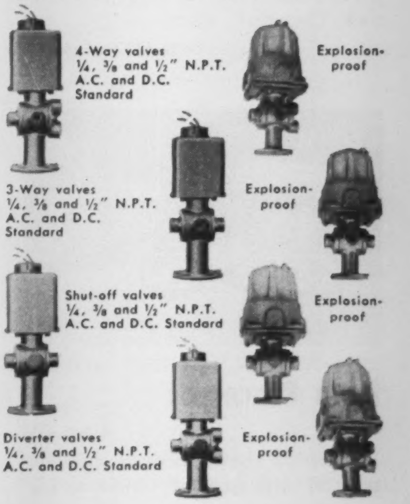
With manual override

3-Way valves
1/4 to 3/4" N.P.T.
A.C. and D.C.
Standard

With manual override

Explosion-proof

DIRECT SOLENOID



4-Way valves
1/4, 3/8 and 1/2" N.P.T.
A.C. and D.C.
Standard

Explosion-proof

3-Way valves
1/4, 3/8 and 1/2" N.P.T.
A.C. and D.C.
Standard

Explosion-proof

Shut-off valves
1/4, 3/8 and 1/2" N.P.T.
A.C. and D.C. Standard

Explosion-proof

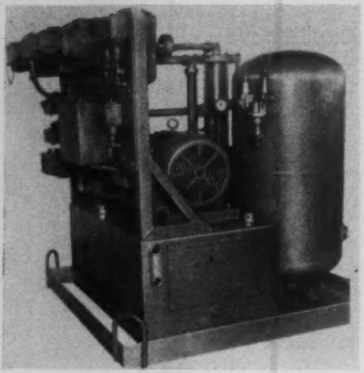
Diverter valves
1/4, 3/8 and 1/2" N.P.T.
A.C. and D.C. Standard

Explosion-proof

Circle 685 on Page 19

tical forces. Side links and pins in Model 458 can be assembled or disassembled without using tools. **Richards-Wilcox Mfg. Co.**, Third St., Aurora, Ill.

Circle 422 on Page 19



Hydraulic Power Unit

Item 423

Designed for press welders, unit features an accumulator which gives instantaneous response to follow up the welding guns as the metal melts. In operation, factory air pressure is supplied to a large air tank through a regulator. The air pressure is held against large-area air cylinders which oppose small-area hydraulic cylinders. The ratio of areas of these two types of cylinders determines the hydraulic pressure needed to force oil into the accumulator. Oil in the accumulator forces a proportionately larger volume of air back into the air tank. The pump is bypassed automatically when the accumulator is full. **J. N. Fauver Co. Inc.**, 51 W. Hancock, Detroit 1, Mich.

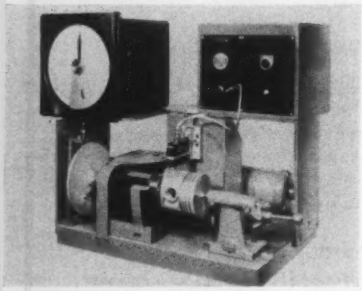
Circle 423 on Page 19

Data Processor

Item 424

Machine simultaneously punches tape or cards as a byproduct of regular accounting jobs such as payroll, accounts payable, accounts receivable, stock records, or general ledger. The control chassis contains a simple plugboard arrangement which allows the machine to be reprogrammed in an office, in the event that there is a change in punching requirements. A removable encoder board permits a choice of 5, 6, 7, or 8-channel tape, or direct connection to an IBM 024-card punch. A motion check built into the tape punch assures that every figure coded by the accounting machine is recorded on the tape. Another feature is an automatic parity check—any malfunction of the tape punch actuates a signal on the control panel, and the accounting machine automatically becomes inoperative. **Monroe Calculating Machine Co. Inc.**, Orange, N. J.

Circle 424 on Page 19

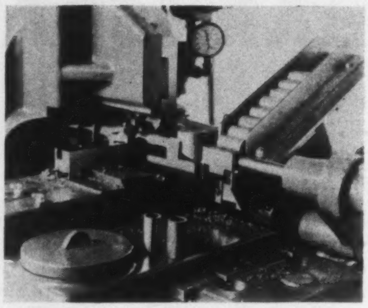


Inspection Machine

Item 425

Equipment can measure and record the changes in the diameter of automotive piston skirts. It is also adaptable for inspecting a variety of other parts for concentricity and out-of-round. The machine is actuated after a piston is positioned and clamped in the fixture. While the part rotates through 360 degrees, changes in the skirt diameter per degree are gaged and recorded on a polar chart. The complete 360 degree contour, recorded in 60 seconds, can be read to 0.0002-inch. At the end of each cycle, the machine automatically stops for the removal of the piston. **Industrial & Automation Div., Radio Corp. of America**, 12605 Arnold Ave., Detroit 39, Mich.

Circle 425 on Page 19

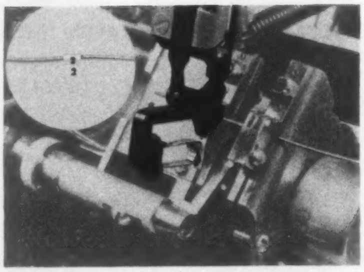


Parts Loader

Item 426

Injector type, automatic parts loader is designed for use on company's swing lathe. In operation, bushings are placed in a feeder chute where they roll by gravity into a loader cradle. While they are in this position, an injector picks up each bushing and feeds it to the lathe. A movable stop locates the bushing on the arbor and then withdraws so that a squaring and chamfering tool can be advanced to face and chamfer both ends of the bushing to length. Meanwhile, a front carriage tool turns the bushing to the prescribed outside diameter. A stripper ejects the finished bushing off the arbor and into an unloading chute while the tools return to the starting point. Production rate is about 550 bronze bushings per hour. **Seneca Falls Machine Co.**, 18 Fyfe Bldg., Seneca Falls, N. Y.

Circle 426 on Page 19

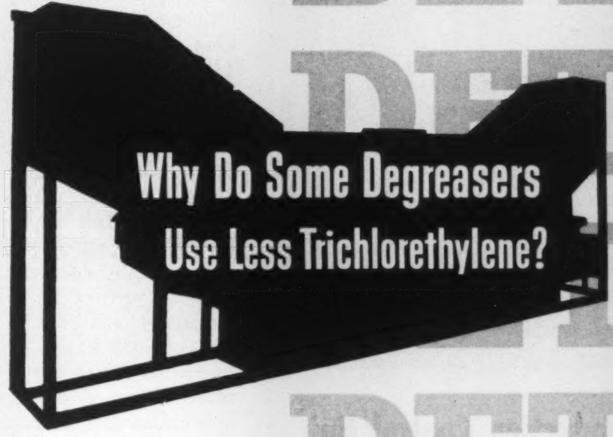


Identification Marker

Item 427

Device, when used as an attachment on company's marking machine, automatically applies pressure-sensitive tape identification around cylindrical, oblong, or tubular shaped objects like wires, small

DETREX
DETREX
DETREX
DETREX



Why Do Some Degreasers Use Less Trichlorethylene?

Unnoticed Changes in a Metal Cleaning Operation Often Affect Solvent Consumption

We were recently asked by a large user of trichlorethylene for a sure procedure for spending the least number of dollars for this chemical.

The procedure necessary to assure the most economical use of trichlorethylene is neither mysterious nor difficult, but it is precise.

To understand it, it is necessary to accept this fact:

1) When a change occurs in the product, or
2) When a change occurs in manufacturing, or
3) When a change occurs in racking, or
4) When a change occurs in the human element, or
5) When a change occurs in the machine –

a change will also occur in the quantity of trichlorethylene being consumed. It is not unusual for one of these changes to occur every month, and many times it will go unnoticed. The *only* procedure that will get the *best* result is:

1) To ascertain the necessary facts, and
2) Have expert appraisal of those facts.

A program can be set up to cover both. We have been doing it for 27 years. We would be very happy to institute such a program for you.

Depend on DETREX for Every Metal Cleaning and Processing Need

- PERM-A-CLOR NA (Trichlorethylene)
- Solvent Degreasers
- Ultrasonic Equipment
- Industrial Washers
- Phosphate Coating Compounds
- PAINTBOND Compounds
- Aluminum Treating Compounds
- Alkali and Emulsion Cleaners
- Rust Proofing Materials
- Extrusion and Drawing Compounds
- Spray Booth Compounds

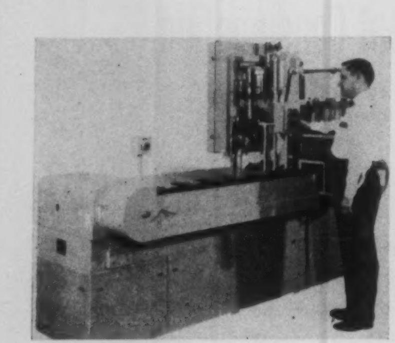
Write for Dr. W. L. McCracken's informative article, "Solvent Degreasing — a Valuable Industrial Process"

DETREX CHEMICAL INDUSTRIES, INC.
Box 501, Dept. A-959 Detroit 32, Michigan

World's Largest Exclusive Producer of Cleaning Chemicals and Equipment components, plastic or metal tubes, bars, and tiny electronic assemblies. Several small pieces can be bundled together with preprinted self-sticking labels, plain precut pressure-sensitive tape, or color coded tapes. Unit, designated Flagmatic, will accept a piece or pieces of material from 1/8-inch OD to material as small as 28 gage wire. Average application rate for 1/16-inch diameter parts is 650 flags per hour.

The flagging method of coding, marking, or bundling is applied to a Model AWM-2 marking machine. Precut, preprinted, or unprinted labels mounted on dispenser cards are used. The card mounted labels are fed into register where a pickup finger disengages a label from its card and positions the label on the object to be marked. Then the attachment engages the label, firming it around the object, and applies friction to the ends of the tape to form a flag. **W. H. Brady Co.,** 727 W. Glendale Ave., Milwaukee 9, Wis.

Circle 427 on Page 19

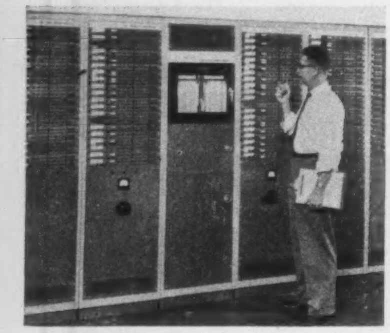


Assembly Machine

Item 428

Standard indexing chassis is tooled to automatically assemble aluminum auto engine components by metal stitching at the rate of 1200 assemblies per hour. Machine indexes a distance of 8½ inches between stations. Idle stations provided can be equipped for additional automatic operations. The unit, which is an over-and-under type machine, can also be converted to oval track operation. To assemble the four-part engine components, an air hydraulic booster is incorporated which operates a stitching die. Machine has an automatic lubrication system. **Benerson Corp.,** Station A, Box 4126, Evansville, Ind.

Circle 428 on Page 19



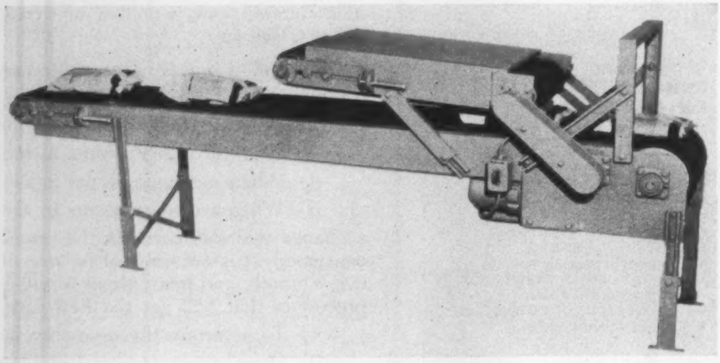
Production Control Unit

Item 429

Production data recording system is capable of automatically switching from one shift to another without disturbing production data recorded for the previous shift, and with no time lag between shifts. Direct communication between shop stations and the control center is through a signalling switch, a *Downtime* switch, and a telephone jack. Sensing devices transmit production information continuously from each shop station to the control center for recording.

Each control panel has dual counters for recording productive time, downtime, and pieces produced. There is one counter to record the balance remaining to be produced. Instrument has two sets of jacks for operator plugs so that operator assignments can be set up on the control panels before the end of a shift. When the time for a shift change arrives, the time clock automatically de-energizes time and output counters for the shift that has ended and cuts in the counters for the next shift. When the information for each station has been taken down (data includes operator's clock number, operation number, machine or station number, etc.) the previous shift counters can be set back to zero to ready the control panels for the next shift. The control panel sounds an audible signal when the run at any station is completed and the balance remaining counter nears zero. This eliminates any over-runs. **Telecontrol Div., Hancock Industries,** Jackson, Mich.

Circle 429 on Page 19



Flattener for Filled and Sealed Bags

Item 430

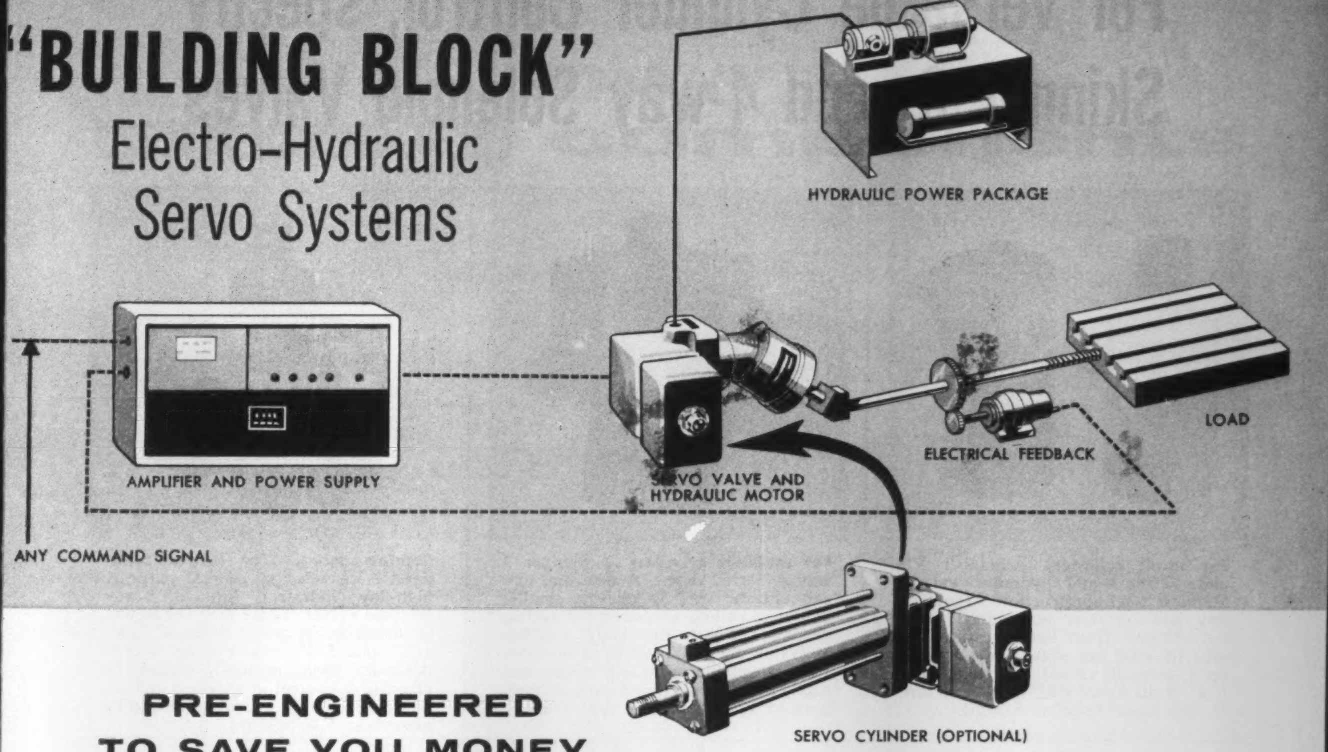
Equipment, which consists of a power conveyor with an inverted feeder driven from the snub pulley shaft, is designed to flatten bags as they come from filling machines. The upper belt of the conveyor can be adjusted for minimum position above the lower belt. Several different bag sizes can be flattened without changing the adjustment. The amount of compression required is obtained by adding weight to a shelf on the upper belt. Model 32 is available in belt widths from 8 to 24 inches. **New London Engineering Co.,** New London, Wis.

Circle 430 on Page 19

A NEW CONCEPT

"BUILDING BLOCK"

Electro-Hydraulic Servo Systems


HYDRAULIC POWER PACKAGE
AMPLIFIER AND POWER SUPPLY
SERVO VALVE AND HYDRAULIC MOTOR
ELECTRICAL FEEDBACK
LOAD
ANY COMMAND SIGNAL
SERVO CYLINDER (OPTIONAL)

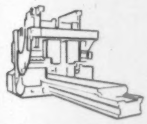
PRE-ENGINEERED TO SAVE YOU MONEY

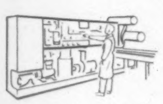
Standard hydraulic and electrical components are now pre-engineered into a series of complete and dependable Electro-Hydraulic Servo Systems. Vickers has the most extensive line of individual "building block" components available for such systems. Inherent "trim flexibility" makes possible systems which will satisfy a very wide range of application . . . at only a fraction of the cost usually incurred in specially engineered systems. A very substantial saving in lead time is now possible.

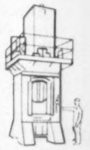
Vickers "Building Block" Closed Loop Servo Systems have proved their merit on machine tools, fabricating machines and processing equipment. The amplifier is precisely matched to the servo valve torque motor. The work load requirement is continuously monitored by electrical feedback devices to insure that directions (command signals) are accurately followed at all times.

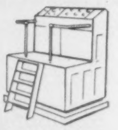
Positional accuracy of better than .001 is obtainable with a hydraulic motor and lead screw. In many position applications, cylinders can be used with similar accuracies. Velocity can be maintained within one or two rpm. In addition to position and velocity controls now in service, constant horsepower and constant tension systems soon will be available. Any command signal may be used with these systems . . . from a simple potentiometer to complete numerical control. For further information, ask for Engineering Bulletin No. 59-75.

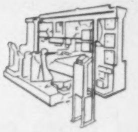
wide range of applications


CUTTING MACHINERY

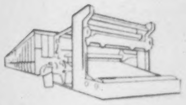

FOOD PROCESSING

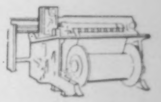

FORMING MACHINERY


TEST STANDS


FABRICATING

ANTENNA DRIVES


PAPER MACHINERY


TEXTILE MACHINERY

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1400 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO* • CINCINNATI • CLEVELAND DETROIT* • GRAND RAPIDS • HOUSTON • INDIANAPOLIS • LOS ANGELES AREA (El Segundo)* • MILWAUKEE • NEW YORK AREA (Springfield, N.J.)* • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • ROCHESTER • ROCKFORD SAN FRANCISCO AREA (Berkeley) • SEATTLE* • ST. LOUIS • WORCESTER
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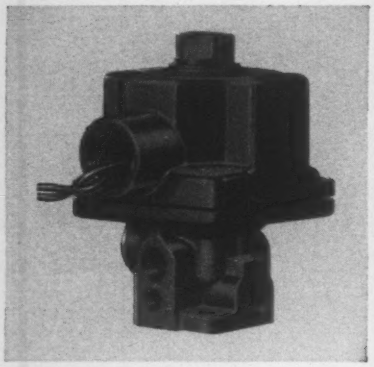
8356

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

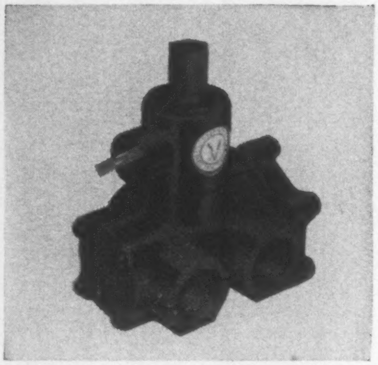
Circle 687 on Page 19

For versatile Cylinder Control, specify Skinner 3- and 4-way Solenoid Valves

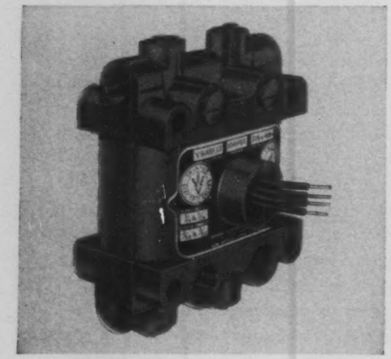
For small cylinders . . . Skinner V5 and V10 air and hydraulic valves. Stainless steel construction. Mount in any position; can be cleaned without removal from line. Pressure ratings to 1000 psi. Available normally open, normally closed, directional control, multi-directional, quick exhaust. Orifice sizes: 3/64" to 1/4".



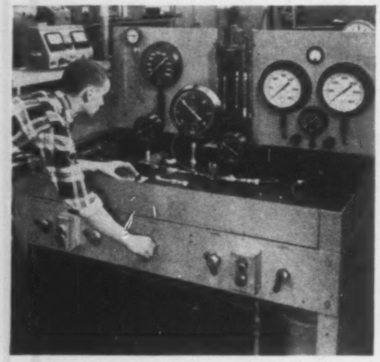
For medium cylinders . . . Skinner 3 way A Series valves. A new line that can also be used to operate smaller cylinders calling for increased cycling speeds. Die-cast, zinc body; stainless steel internal parts; mount in any position. Available normally open, normally closed, directional control. Pressure to 125 psi; orifice size, 5/32".



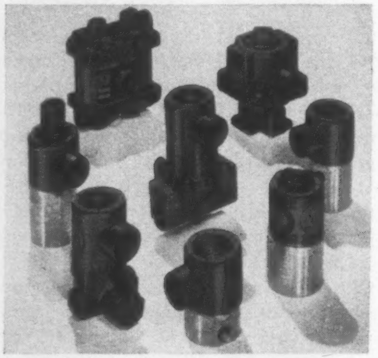
Coming soon . . . for larger cylinders! A new-design, general purpose, high-flow industrial line of 3-way solenoid valves. These new valves will be available in orifice sizes of 3/8", 1/2" and 3/4" and will be offered normally open, normally closed, or directional control in standard and explosion-proof construction. Operating pressures: 5 to 150 psi.



For double-acting cylinders . . . Skinner 4-way V9 valves. Two 3-way valves in one housing offered normally closed-normally closed, normally open-normally open, and normally closed-normally open. Available with adjustable flow features for exceptional cylinder control. Orifices: 3/64" to 1/8". Pressure ratings to 200 psi.



Exhaustive lab tests assure that you can use any Skinner valve with confidence. Built to the highest UL standards, Skinner valves are completely tested and checked to provide the best product available. Skinner's testing standards meet or surpass those of the aircraft industry.



A complete line of 2-, 3- and 4-way solenoid valves. There's a Skinner valve for almost any flow application with a wide variety of media: air, oil, water, inert gases, hydraulic fluids, kerosene and gasoline. Orifice sizes range from 3/64" to 1". Pressure ratings range from vacuum to 3000 psi. Explosion-proof models are UL approved for Class 1, Group D and Class 2, Groups F and G.

Skinner solenoid valves are distributed nationally

For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at Dept. 329.

SKINNER ELECTRIC VALVES ®

THE CREST OF QUALITY

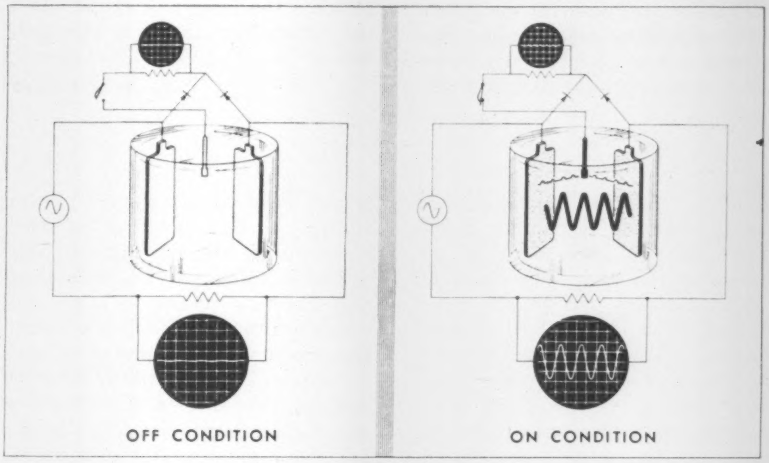
THE SKINNER ELECTRIC VALVE DIVISION • NEW BRITAIN, CONNECTICUT

Circle 689 on Page 19

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 19.



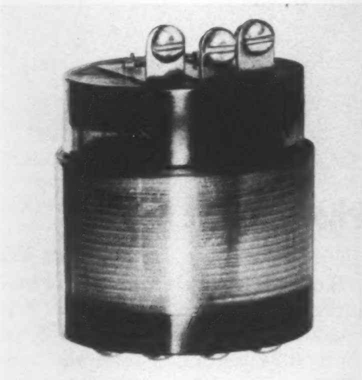
OFF CONDITION

ON CONDITION

A self energized method of excitation of an amplifier can be achieved through the use of two diodes which block ac to the grid control circuit and allow the application of pulsating dc potential of the proper polarity upon the grid and load-connected electrodes.

Control Switches and Modulates AC Circuits

STATIC component, for switching and modulating current flow in ac circuits, is manufactured by **Ovitron Corp.**, 14830 Schaefer Highway, Detroit 27, Mich., and designed on the theory of electroionic surface impedance control. The device consists of two load-connected electrodes and a grid control element immersed in an electrolytic bath.



Static control unit has load voltages of 3 v ac minimum, 70 v ac maximum.

Principle of operation is to apply a small energy stimulus to a permanently sealed cell through a grid control element. Under the influence of this stimulus, the nonconducting surface films on the two load-connected electrodes are instantaneously changed from their nonconductive or semiconductive state to a conductive state, allowing current to flow from one load electrode to the other through the electrolytic fluid. This load current is entirely controlled by the small energy stimulus, and can be switched on and off or modulated. When the control signal is removed from the grid element—or when another signal of opposite polarity is applied—the conductive surfaces of the load electrodes are immediately restored to their original nonconductive state, blocking the flow of current through the device. Flexibility of design permits the devices to be used as proximity switches, logic devices, circuit breakers, error detectors, modulators, amplifiers, regulators, and time delays. Unit ratings per single cell for load voltage are 3 v ac minimum, 70 v ac maximum, with load currents ranging from milliamperes to 15 amp.

Circle 431 on Page 19

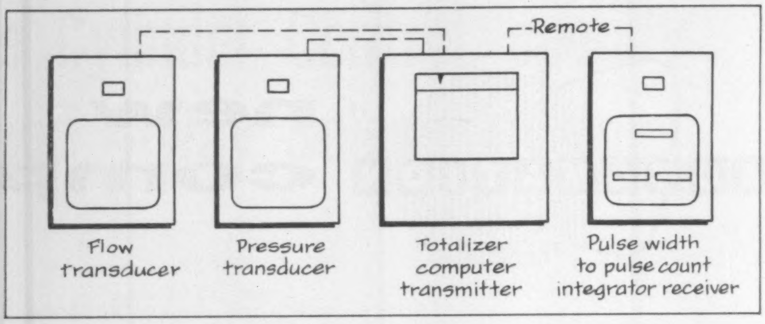
Computing Telemetering System

Item 432

Computing telemetering system designed for corrected flow measurement in the gas and pipeline industry is also suitable for other flow problems. Components in the system include a flow transducer, pressure transducer, totalizing computing and transmitting instrument, and a pulse-width to pulse-count transducer-type integrator with counters.

The flow and pressure transducers are null-balance instruments. A signal determined by the measured variable (variable can be temperature, flow, or pressure) is fed from the error-detector to an amplifier. The amplified signal is fed to a servomotor which positions a servo shaft for operating a retransmitting slidewire, encoder, alarms, or deviation contacts. The feedback cam on the servo shaft can be contoured to provide exponential values. The totalizing computing instrument has downscale fail-safe action and a Metameter transmitter. Manual adjustments are included for specific gravity and supercompressibility. There also are range change switches and check switches for introducing finite values of temperature, pressure, flow, specific gravity, and supercompressibility. A flashing red light indicator in the door shows when any switch is in check position. The integrator receives the output signal from the transmitter and converts the pulse-width signal to pulse-count. Integrator has a cumulative counter and two counters for hourly totals. It has a wide rangeability from 50-1. A relay matrix automatically switches the integrator range when the transmitter range is changed. **Bristol Co.,** Waterbury 20, Conn.

Circle 432 on Page 19


-Remote
Flow transducer
Pressure transducer
Totalizer computer transmitter
Pulse width to pulse count integrator receiver

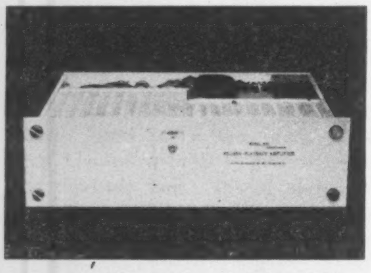
Rotary Position Display

Item 433

Electronic device provides a straight decimal display of position of a rotary or linear moving member from shaft position data of an analog-to-digital position transducer. The position display is with respect to any arbitrary origin preselected by the unit. Suitable applications include an area such as registry of color plates in multicolor printing processes. Unit, designated Zerotron, combines a position display with a manual origin selector. The origin selector consists of a row of selector switches (one per digit) with 10 detent positions. The switches are used to zero-set the display to read position measured from the new origin. Once the selector switches are set for a preselected reference point, the circuitry automatically performs the offset calculation throughout the travel of the moving member.

Input to the unit is from an analog-to-digital converter slaved to the moving member. The digital binary coded signal indicating position is presented in parallel to the circuitry. A relay matrix in the display performs a parallel digital subtraction for each digit of the dimension fed to it. The position display converts the binary coded decimal to a 1-out-of-10 decimal reading. The difference between the absolute analog-to-digital converter reading and the setting of the manual origin selector switches appears on the display in straight decimal form. Unit is available as complete zero-reference display systems including a power supply for the display and transducer as well as transducer logic and driver circuitry. It can also be furnished without power supply and transducer circuitry. **Norden Div., United Aircraft Corp.,** Data Systems Dept., 13210 Crenshaw Blvd., Gardena, Calif.

Circle 433 on Page 19



Magnetic Tape Amplifier

Item 434

Model 921 is a write/read amplifier for digital magnetic tape transports. Tape speeds from 1 ips to 150 ips can be accommodated, with a response to minimum signal levels as low as 150 mu v. It can be used with existing return to zero and nonreturn to zero recording systems. Instrument offers a choice of dc level or preselected pulse width for output use. Features of the amplifier are: Gated output for direct strobing, clock playback for data strobing, IBM clock generation, and a choice of read-write switching mode. **Potter Instrument Co. Inc.,** Sunnyside Blvd., Plainview, N. Y.

Circle 434 on Page 19

AUTOTRON INC

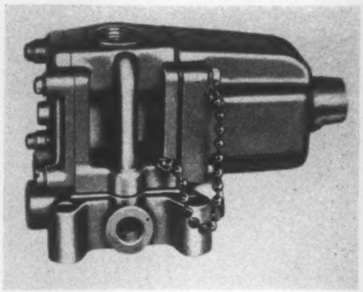
Photoelectric Control

Item 435

Tubeless photoelectric control features transistorized circuitry, will operate on 10 ft-c minimum light with 0.04 second minimum dark time and 0.04 second minimum light time. The control relay energizes when light is on the sensing element. The sensing element is mounted behind a small opening in a shield which is located 2 inches back of the lens. This design is said to eliminate extraneous light.

Contacts are SPDT, silver cadmium oxide, rated 8 amp at 115 v ac, noninductive load. The case of Model BT1 has an adjustable mounting bracket for ease in mounting the unit in alignment with the light source. It is tapped for a ½-inch conduit. Unit can be furnished with a variety of light sources and miniature remote sensing heads. **Autotron Inc.**, Box 722 RR, Danville, Ill.

Circle 435 on Page 19



Air Valve

Item 436

Miniature air valve is applicable to automatic assembly and packaging machines. Units are available as a single solenoid spring return four-way, or a double solenoid momentary contact four-way. Valve can operate cylinders having up to 4-inch bores in applications where high piston speeds are not a consideration.

It is suitable for vacuum or air pressures to 300 psi. Performance rates are up to 450 operations per minute for continuous duty and 600 operations per minute for intermittent duty. If the unused ports are plugged up, the unit can be used as a normally open or normally closed two-way or three-way valve. It can also be used as a selector valve or as a diverter valve to divert the flow from a common inlet to either of two outlets. Inrush current for the valve is is 0.85 amp and holding current is 0.23 amp on 115 v, 60 cycle current. Standard voltages are 115 and 230 v, 60 cycles. **Numatics Inc.**, Highland, Mich.

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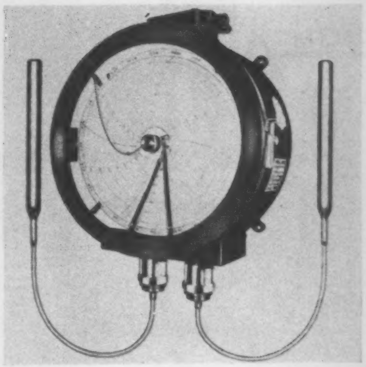
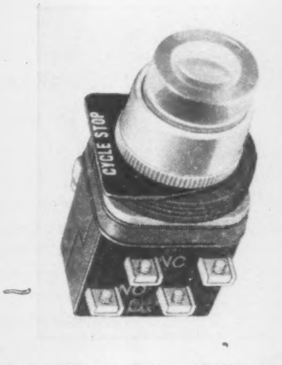


Recording Thermometer

Item 437

Dual recording thermometer can sense and record temperatures up to 1100 degrees simultaneously in two locations. Model TRH has two thermal sensing elements and two pen mechanisms in the same body. The pens operate on a two-hour differential to prevent any interference in the event that both sensed temperatures are alike. The recording arms, driven by compounding levers that transmit expansion and contraction of mercury columns, are enclosed in a dust-tight case. Units are available with either electric or spring drives for the 10-inch circular charts. Ten scale ranges are applicable to the thermometer—elements of the same scale range are interchangeable, regardless of the bulb type. **Partlow Corp.**, 525 Campion Rd., New Hartford, N. Y.

Circle 437 on Page 19



Illuminated Pushbutton

Item 438

A pilot light is combined with a pushbutton to produce an illuminated oiltight pushbutton unit. The flexible circuitry permits the pilot lamp to be wired to go *On* or *Off* when the button is pressed; or it can be engergized from a separate source. The unit can be wired as a push-to-test pilot light. The contact blocks have double break NO-NC contacts of silver alloy that do not require maintenance. A step-down transformer is built into each unit to supply the 6 v pilot lamps. Button type lenses in a variety of colors and guard collars to protect the button are also available. The guards can be used with a padlock to lock the button in its down position. **Allen-Bradley Co.**, 136 W. Greenfield Ave., Milwaukee 4, Wis.

Circle 438 on Page 19

Three Phase Monitor

Item 439

Instrument detects electrical faults in a system, gives both visible and audible signals for unbalanced transformer loads, grounds, single phasing, and loose connections. The minimum and maximum voltage warning points can be set for each phase. If the voltage drops below these points, a phase pilot light goes on and the alarm bell rings. The cause of the difficulty can be determined by reading the three voltmeters and comparing them with the illustrated meter charts on the face of the instrument. Color coded dials on the front panel of the voltmeters provide easy identification of unsatisfactory voltage conditions. Monitor has a standard voltage of 120 v. The built-in alarm system is 6 v and the remote alarm can be any voltage from 6 to 120. **Principle Research & Development Corp.**, 200 Citizens Bldg., Aberdeen, S. D.

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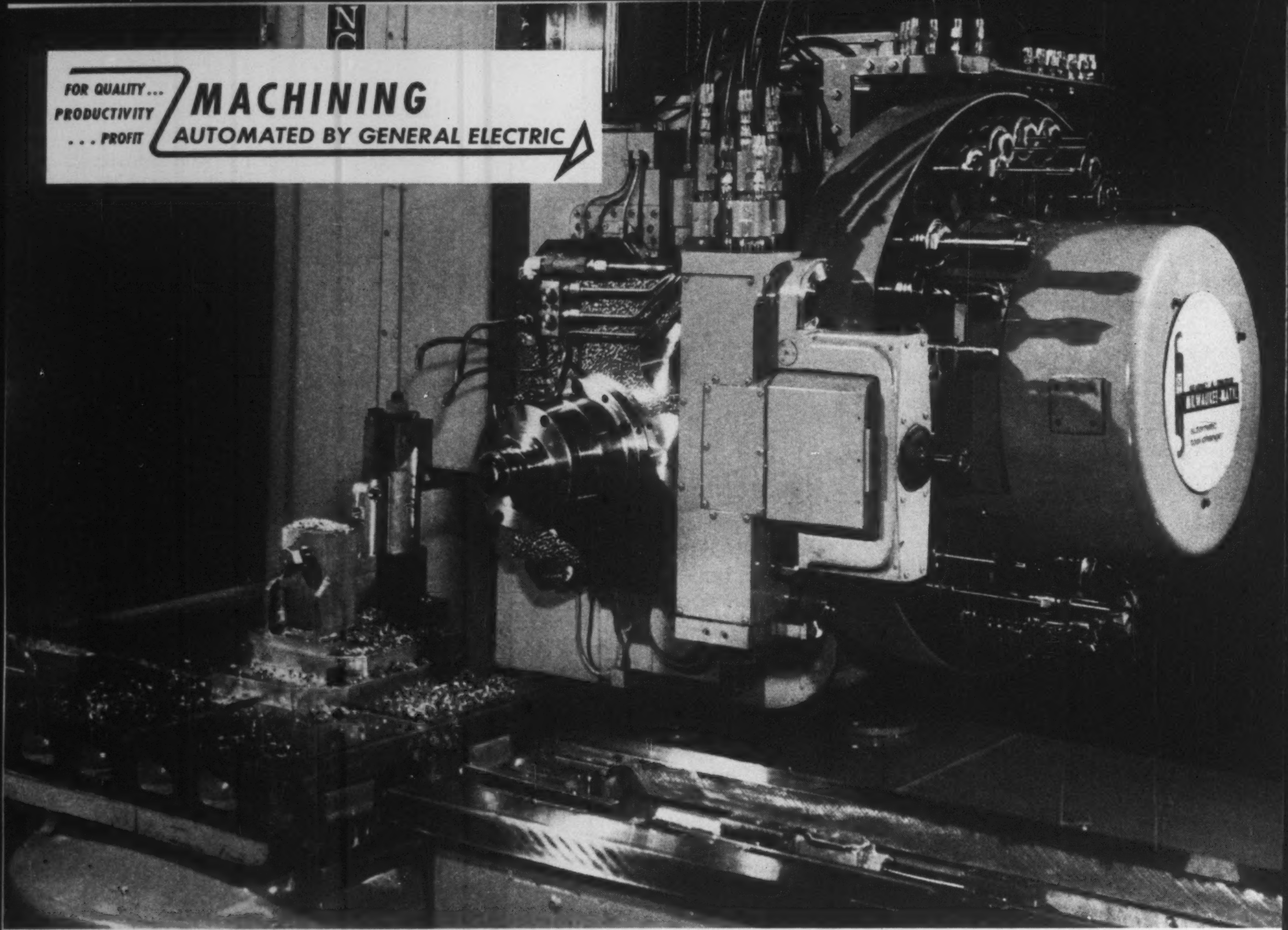


FOR QUALITY . . .
PRODUCTIVITY
. . . PROFIT

MACHINING
AUTOMATED BY GENERAL ELECTRIC

ELIMINATE SPECIAL TOOLING COST

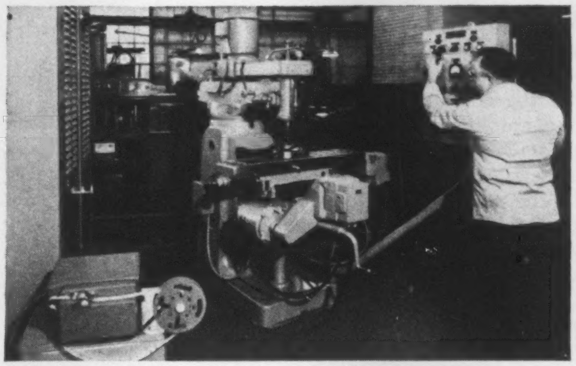
MARK SERIES NUMERICAL CONTROLS . . .

. . . . . . standard, job-proved packages now in use on a wide variety of machines

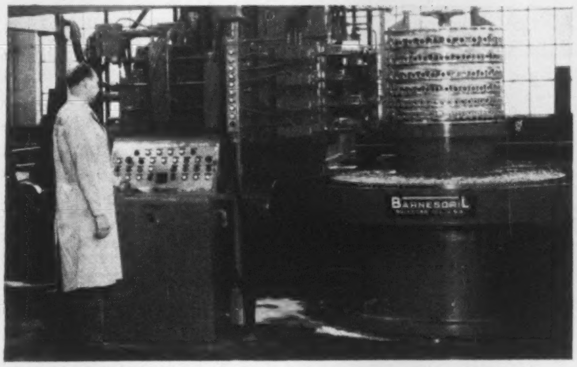
General Electric's Mark series of standard, pre-engineered numerical control packages—with systems for controlling 1 to 5 motions plus machine auxiliary functions — are compiling impressive performance records on scores of machines throughout American industry today.

Machine operation is completely automatic—from punched tape prepared on a standard automatic typewriter. If desired, semi-automatic positioning, useful for prototype work, is obtained with manually set dials on the control station.

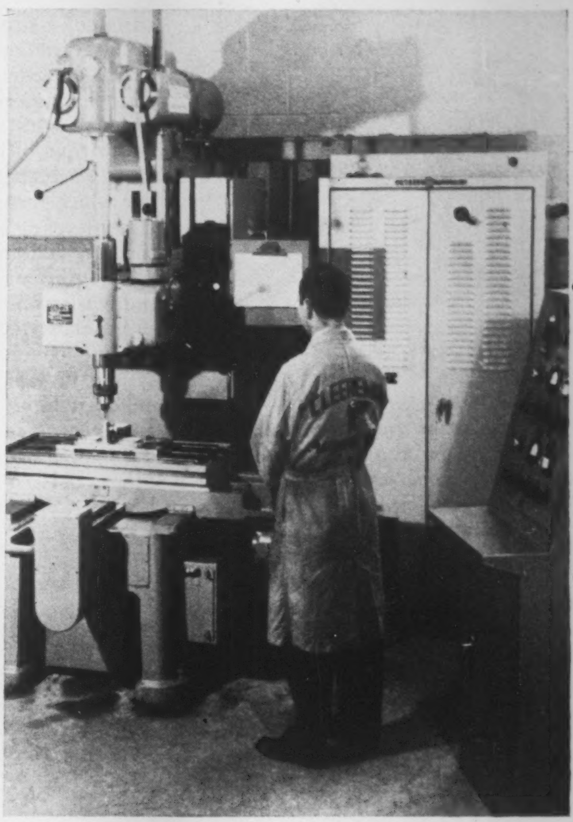
Key components of a typical Mark package are a controller, a punched tape reader, operator's control station, servo drives and position-sensing units.



60-80% LESS FIXTURE COST is average for all new parts produced on this general-purpose milling machine. Tooling expense saving for one part totaled $2000.



TOOLING EXPENSE CUT from $5000 to less than $100; 248 critical holes spotfaced, drilled, bored, counter bored, and chamfered with no jigs or templates.



NO JIGS ARE NEEDED on this G-E controlled layout drilling machine. Tooling cost on one part was reduced from $1350 to $20; $1000 worth of fixtures eliminated on another job.

with General Electric numerical control

Eliminate jigs, cut lead times, save costly tool storage space

A key benefit of General Electric numerically controlled machines is the elimination of special tooling cost in application after application. Reports show jigs, templates, and complex fixtures are absolutely unnecessary—being replaced even in the most intricate jobs by simple holding clamps.

What does this mean to you? It's the end of costly tooling . . . it's shorter lead-time cycles . . . less investment in tool storage and maintenance . . . more flexibility in production scheduling.

Many manufacturers find that savings on tooling costs *alone* will pay for their G-E numerically controlled machines. As an example, on a group of six parts, with a variety of operations performed by a multi-purpose tape controlled machine, tooling savings totaled over $10,000 with cost reductions on a single part from $1890 to $260. With less than 100 such parts, the machine is paid for.

In a routine drilling job, $1300 worth of jigs were replaced with a simple $20 holding clamp.

And, another Mark II controlled drill press more than paid for itself in a few weeks. More than 120 different drill jigs—which would have cost $186,000—were *not* made. These savings alone totaled more than 6 times the original investment in the numerically controlled machine!

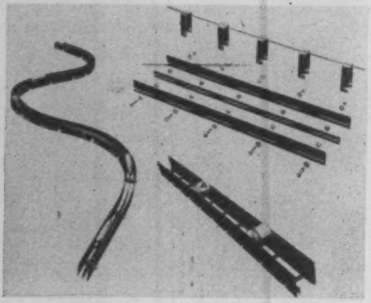
Join with the more than a hundred manufacturers who are increasing worker productivity, gaining better product quality, and eliminating special tooling cost with G-E numerically controlled machines. See your G-E Apparatus Sales Engineer or machinery builder today. General Electric Co., Specialty Control Dept., Waynesboro, Va.

795-6

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle 690 on Page 19



Flexible Chuting

Item 440

Suitable for gravity-fed rolling or sliding part conveyance, flexible chuting units consist of spring steel side and ride rails which can be easily assembled at the point of use. Designated FabriFlex, the chuting is of bolted construction, does not require shop fabrication or special tools. It can be routed around building obstructions and cut to length at the time of installation. All chuting rails are available in coils and can be used with fixed, oscillating, or reciprocating feed installations. The open-channel design allows machining chips and foreign matter to drop through. Electrical interlocks for automatic flow control can be easily mounted by using the chuting assembly bolts. **F. Jos. Lamb Co.**, 5663 E. Nine Mile Rd., Detroit 34, Mich.

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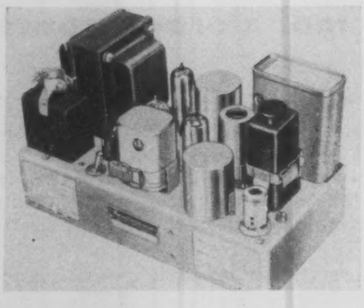


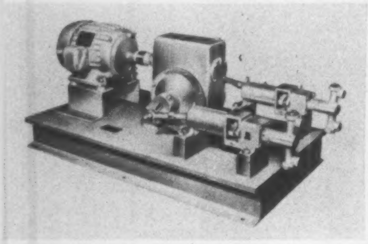
Relay Control Amplifier

Item 441

Instrument has a sensitivity of 1 mu v and stability of ±1 mu v, is adaptable for any industrial process control and monitor system where the transducer generates a change in voltage or resistance that is representative of the measured variable. Electrical interference, extreme variations in power supply, and high external input resistance do not interfere with the operating characteristics of the amplifier.

Principle of operation is that the unit is a high gain dc to ac amplifier which recognizes the polarity of a low-level dc input signal, converts it to ac, and amplifies it to a signal with sufficient strength to actuate the master relay in accordance with that polarity. A safety feature is a fail-safe circuit which protects the system in which it is used against an open input circuit or failure of any critical amplifier component. The power supply will operate on 115 v, ±10; 50 to 60 cps. **Thermo Electric Co. Inc.**, Saddle Brook, N. J.

Circle 441 on Page 19

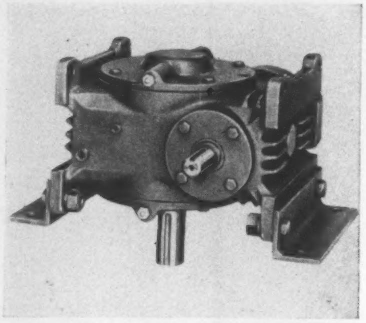


Metering Pump

Item 442

Line of controlled capacity metering pumps includes both plunger-type and diaphragm-type metering units. Both types operate on the reciprocating action of a positive-displacement plunger except that the diaphragm pump has a hydraulically-balanced teflon diaphragm between the plunger and the pumped liquid. A feature of the pump is the straight-column, drop-out construction of the liquid end. Free-floating ball-check valves, enclosed in precisely dimensioned cages, are stacked vertically within the liquid-end housing. This design is said to give improved flow characteristics and provides easy removal of the valves for cleaning. Various styles of pumps range in capacity from one drop every 13 strokes to 1000 gph, at discharge pressures to 10,000 psi. The flow output for any size pump is adjustable from zero to 100 per cent capacity. **Clark-Cooper Co. Inc.**, 300 Market St., Palmyra (Burlington County), N. J.

Circle 442 on Page 19

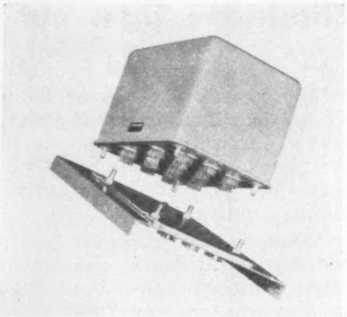


Worm Gear Speed Reducer

Item 443

Unit is available in 2½, 3, 3½, and 4-inch centers with up to 13½ hp input rating and 7240 lb-in. output torque rating. The worm gear speed reducer can be mounted in three different positions—worm shaft below the gear, worm shaft above the gear, and the output shaft vertical (shown). Features of the unit include: Anti-friction roller bearings; cast iron housing of one piece construction, worm shaft of one piece construction (nickel steel forging); and automatic splash lubrication from the oil reservoir to internally cast guiding ribs. Cooling is provided by an aluminum radial fan which directs air over the ribbed sides of the gear case. The fan is designed to operate in either direction of rotation. **Link-Belt Co.**, Dept. PR, Prudential Plaza, Chicago 1, Ill.

Circle 443 on Page 19

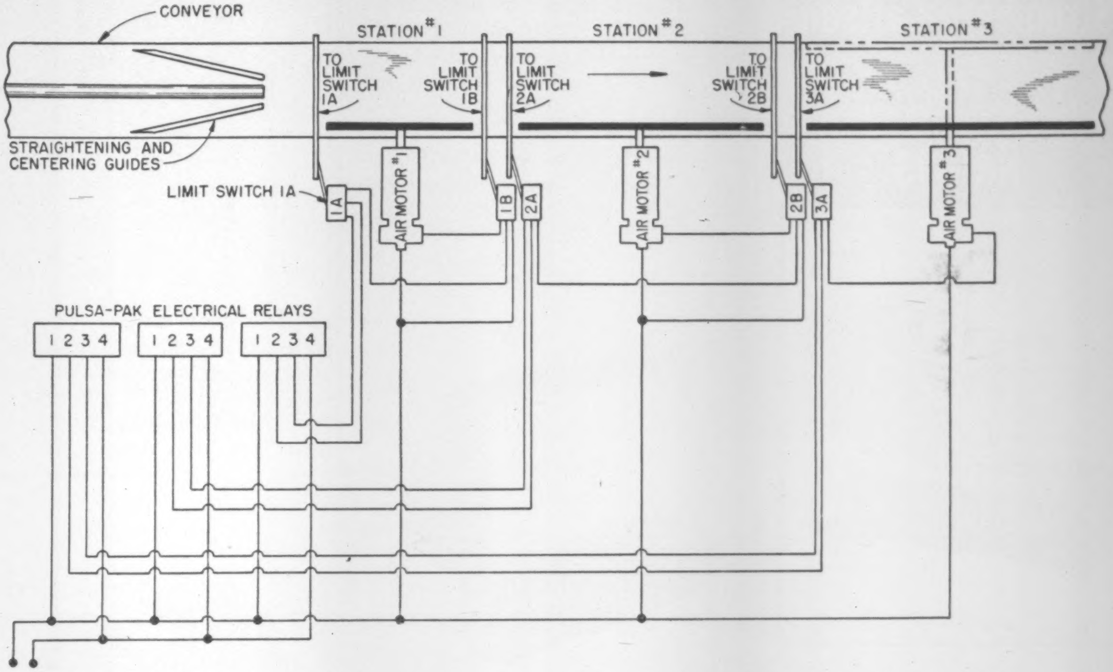


Rotary Stepping Switch

Item 444

Line of rotary stepping switches features plug-in connectors of any type. Type 45 (shown) has a hermetically sealed enclosure with multiple-pin heads for straight plug-in. By jacking the unit into a

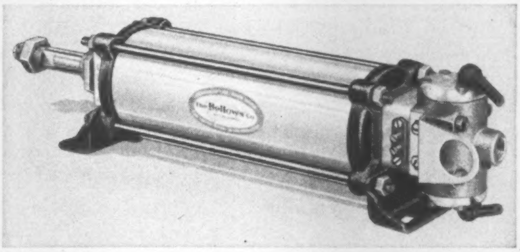
BUILD THIS LOW-COST AUTOMATIC SORTER IN YOUR OWN PLANT


CONVEYOR
STATION #1
STATION #2
STATION #3
TO LIMIT SWITCH 1A
TO LIMIT SWITCH 1B
TO LIMIT SWITCH 2A
TO LIMIT SWITCH 2B
TO LIMIT SWITCH 3A
STRAIGHTENING AND CENTERING GUIDES
LIMIT SWITCH 1A
1A
1B
2A
2B
3A
AIR MOTOR #1
AIR MOTOR #2
AIR MOTOR #3
PULSA-PAK ELECTRICAL RELAYS
1 2 3 4
1 2 3 4
1 2 3 4

This "SPOT-A-MATION IDEA" is typical of the ways versatile Bellows "Controlled-Air-Power" Devices are being used to automate operations in plants of all types and sizes. This unit sorts mixed lengths of lumber. Inexpensive, simple and easy to construct, with only minor changes it could sort packages, products and materials, discharging them into appropriate bins, chutes, accumulating conveyors, etc.

As now used, any piece of lumber shorter than the length of the first discharge station will release limit switch 1A before tripping switch 1B. Under these conditions, the piston rod of Bellows Air Motor #1 will advance, eject the piece from the conveyor, and retract. If, however, the item is *longer* than the unloading station, switch 1B will be contacted *before* switch 1A is released, and the Air Motor will not be actuated As pieces progress through the various stations (any number can be incorporated), successively longer lengths are discharged. At the last station, pieces of lumber are unloaded after the switch at the entrance has been tripped and released. Switches can be actuated either by mechanical means, as shown above, or by photoelectric cells.

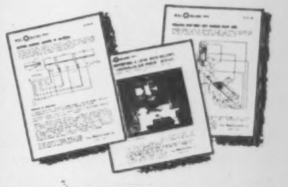
Every day, Bellows "Controlled-Air-Power" is increasing production per man-hour and improving quality in thousands of plants throughout the world. Chances are it will pay off in *your* plant, too. It costs you nothing to investigate.



This is the Bellows Air Motor — the precision Air Motor — the first air cylinder with built-in directional valve, valve operating controls and piston rod speed controls. Compact, easy to install and lightning-fast in operation, it is the key to "Controlled-Air-Power" and the heart of Bellows integrated work units.

1388-B

THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST



Contains installation data, wiring diagrams and equipment lists for the automatic sorter and other Bellows "Controlled-Air-Power" applications, enabling you to automate existing machines, or build your own low-cost special-purpose equipment. Write for yours today. Address Dept. AU959, The Bellows Co., Akron 9, Ohio

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

AKRON 9, OHIO

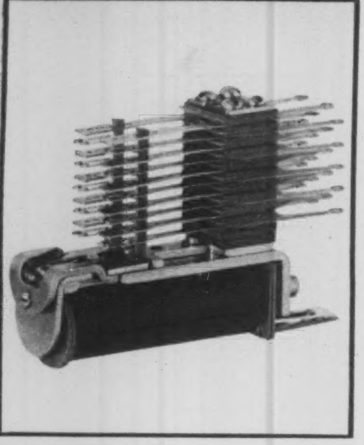
OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V D Anderson Co., Cleveland, Ohio

Circle 691 on Page 19

Stromberg-Carlson

"TELEPHONE QUALITY"

Relays



. . . featuring new high-voltage types for test equipment or other high-voltage applications.

THE insulation in the new relays carries 1500 volts A.C.—three times normal. These high-voltage models are available in Types A, B and E. They are the latest additions to the Stromberg-Carlson line of twin contact relays—all available for immediate delivery.

The following regular types are representative of our complete line:

***Type A:** general-purpose relay with up to 20 Form "A" spring combinations. This relay is excellent for switching operations.*

***Type B:** a gang-type relay with up to 60 Form "A" spring combinations.*

***Type BB:** relay accommodates up to 100 Form "A" springs.*

***Type C:** two relays on the same frame. A "must" where space is at a premium.*

***Type E:** has the same characteristics as the Type A relay, plus universal mounting arrangement. Interchangeable with many other makes.*

Complete details and specifications are contained in our new relay catalog, available on request. Write Stromberg-Carlson Telecommunication Industrial Sales.

STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**
111 CARLSON RD. • ROCHESTER 3, N.Y.

Circle 692 on Page 19

matching socket mounting plate, 462 connections can be made in a few seconds. Four bolts, located asymmetrically, are used for orienting the enclosure and for engaging and disengaging the unit. Another unit, a miniature rotary stepping switch, Type 44, is available as a prewired, quick-connect unit in an AE-4400 enclosure. **Automatic Electric Co.,** Northlake, Ill.

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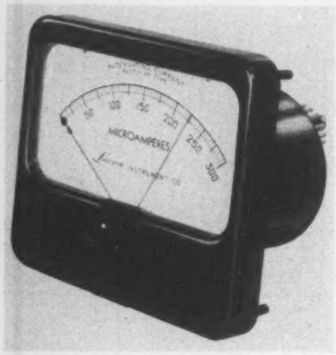


Meter Controller

Item 445

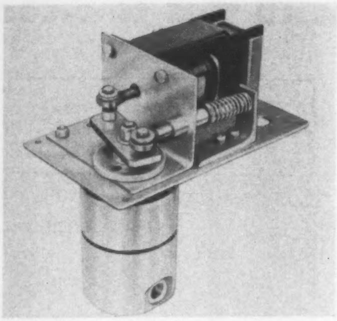
Transistorized instrument continuously indicates any electrical variable and provides high or low limit control. Model MR consists of a contact meter, built-in transistor amplifier power supply, and load relay. Unit has a plug-in feature for easy connection of external wiring such as the input signal and load. The input signal can be as low as 1 mu w at less than 1 microampere or as high as several thousand volts or amperes. The control point can be adjusted over the entire scale range by means of a control knob located on the front of the instrument. Unit can be used for both continuous automatic control or limit control. **Larson Instrument Co.,** 24 Orchard St., Tarrytown, N. Y.

Circle 445 on Page 19

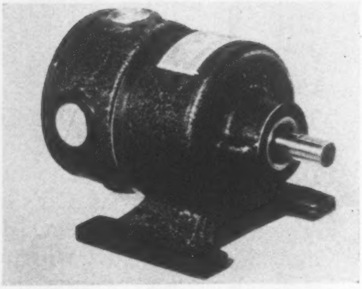
Solenoid Valve

Item 446

Line of solenoid valves, rated for 10,000 psi liquid or gas, is available in 1/4, 3/8, and 1/2-inch port sizes. Units are designed for a burst pressure of 30,000 psi. Features of the unit are the optically flat metal to metal sealing surfaces which are protected by staying in constant intimate contact. Solenoid is furnished for 115, 230, and 460 v ac operation. **Barksdale Valves,** 5125 Alcoa Ave., Los Angeles 58, Calif.



Circle 446 on Page 19

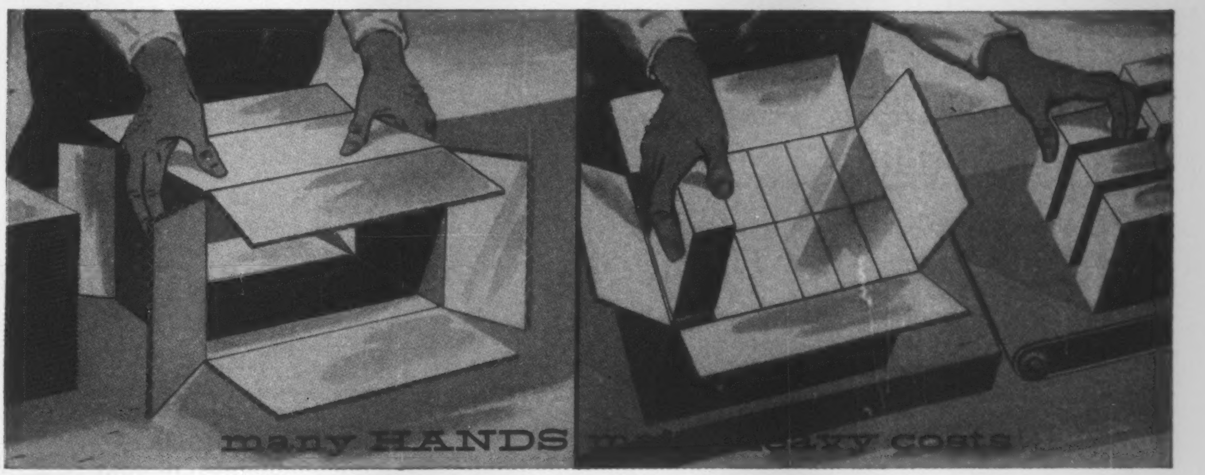


Zero Speed Switch

Item 447

Line of zero speed switches has magnetically actuated contacts operated by hydraulically driven mechanisms. They can open or close signal circuits on shaft speeds as low as 15 rpm and can be driven at speeds ranging through 3800 rpm. Silicone oil is used as the hydraulic fluid to lend stability to repeat contact operation over a temperature range from −20 to 250 F. The switches have hardened and ground 1/2-inch shafts which are supported by two spaced 1/2-inch precision ball bearings. The required driving torque is approximately 4 oz-in. Units will operate in any position and are available in either flange or base-mounted types. Electrical contacts are snap action, totally enclosed type, rated for 10 amp at 125/250 or 460 v ac; 1/2 amp at 125 v dc; and 1/4 amp at 250 v dc. **Winterburn Mfg. Co.,** Putnam, Conn.

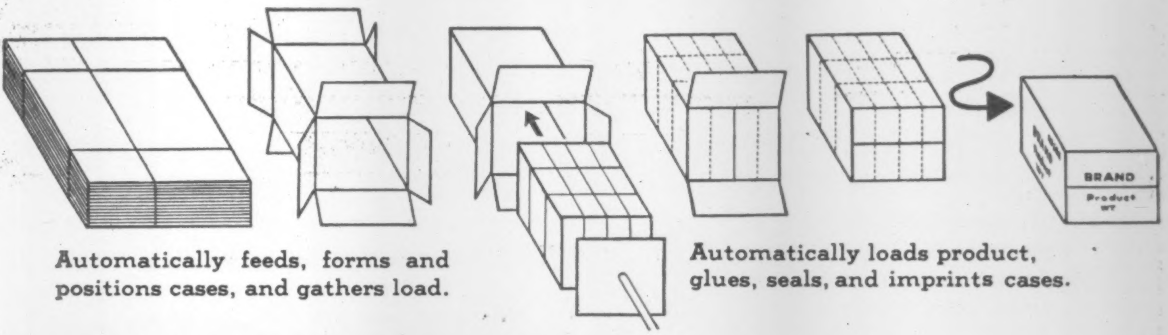
Circle 447 on Page 19


many HANDS mean heavy costs

let **Packomatic**®
T.M. Reg. U. S. Pat. Off.

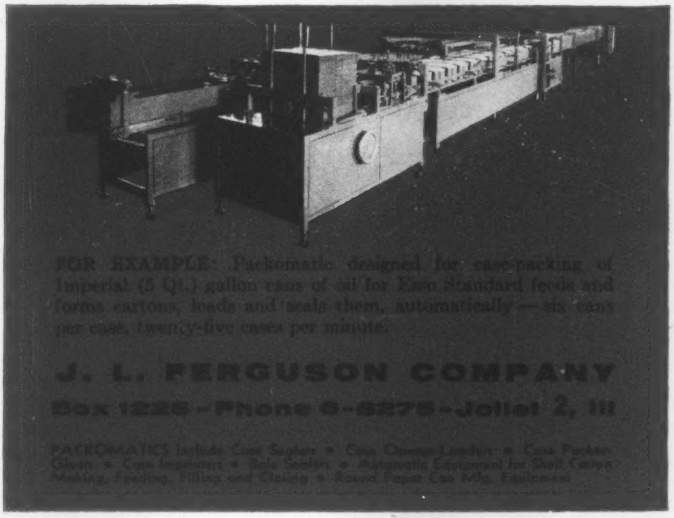
equipment do any or all your casing operations

AUTOMATICALLY



Automatically feeds, forms and positions cases, and gathers load.

Automatically loads product, glues, seals, and imprints cases.



FOR EXAMPLE: Packomatic designed for case-packing of Imperial (5 Qt.) gallon cans of oil for Esso Standard feeds and forms cartons, loads and seals them, automatically — six cans per case, twenty-five cases per minute.

J. L. FERGUSON COMPANY
Box 1226 - Phone 6-6275 - Joliet 2, Ill

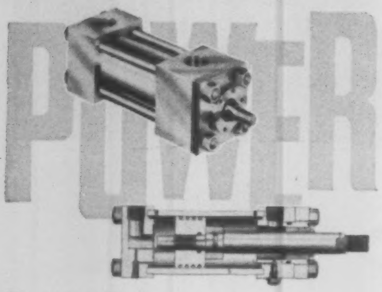
PACKOMATICS include Case Sealers • Case Opener-Loaders • Case Packer-Gluers • Case Imprinters • Bale Sealers • Automatic Equipment for Shell Carton Making, Feeding, Filling and Closing • Round Paper Can Mfg. Equipment

For casing round, square, rectangular or free-form packages of virtually any size

You need not be a **big** company to enjoy the economies of Packomatic equipment. If your volume requires even one person to hand-form cases, hand-fill, hand-seal, or hand-imprint them, then a Packomatic machine can be a sound investment. Only a minute or two of attention at infrequent intervals is needed even for a **complete** automated Packomatic **line,** capable of matching the output of a dozen pair of hands. And in addition to reducing direct labor production costs Packomatic can, by utilizing end-opening shipping cases, reduce your paper-board costs up to 25%. And mechanically end loaded cases are stronger because the flaps give added resistance to weight and shock. In addition they stack better because their uniformly flat sides enables keying of pallet loads. Write, wire or phone us for facts on how to reduce your case packing costs.

Circle 693 on Page 19

there's **power** to spare in **O-M** heavy-duty **Hydraulic** (oil) **Cylinders**

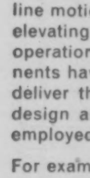


Series TH
2000 psi operation
3000 psi non-shock
Available in 1½″ to 8″ bores
Meet JIC Standards

IF you need smooth, dependable straight-line motion for heavy-duty pushing, pulling, elevating, lowering, clamping or knock-out operations, these powerful, O-M components have what it takes and more, too. To deliver this plus in power, every essential design and construction feature has been employed.

For example, these units are ruggedly constructed of heavy wall seamless steel tubing microhoned to minimize friction. The ports are large and unrestricted. They can be located at 90-degree positions. These cylinders are sealed right to prevent power loss. The piston rod is stress relieved, turned, ground and polished, high tensile steel, chrome plated. In addition, the rod gland cartridge, accurately piloted in the rod head to assure perfect alignment, is easily unscrewed and removed. Pilot O.D. of cartridge serves as pilot for cylinders mounted on rod end. A cushion ball check valve provides for rapid, full power start of return stroke.

These and many other advancements are described in our latest catalog No. 105. Write for your copy TODAY or consult your local O-M representative.

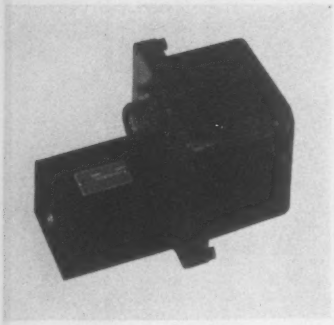


ORTMAN-MILLER MACHINE CO.
25 143rd Street, Hammond, Ind

☐ Have representative call
☐ Send Bulletin 105

Name__________ Position________
Company________________
Address________________
City________ Zone____ State_______

Circle 694 on Page 19



Servo Control Valve

Item 448

Model SS102 is an electrohydraulic servo valve of single stage design. It uses a powerful torque motor to position a 3- or 4-way valve spool. Torque motor coils can be supplied to meet requirements of different control circuits. Specifications for the valve are: Supply pressure 1500 psi, flow 6 gpm, power output 4 hp, power input 5 w, internal leakage 0.2 gpm, and hysteresis 2.5 per cent. **Hydraulic Controls Co. Inc.**, 217 California St., Newton 58, Mass.

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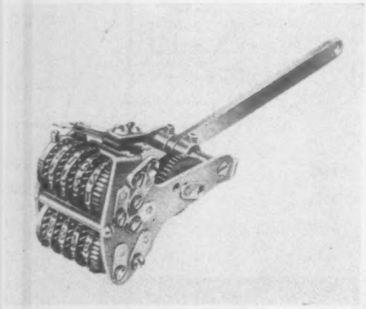


Counter/Printer

Item 449

Direct readout swinging head counter continuously prints digital data ranging from plus through zero to minus numbers and vice versa. True numerical values and symbols are printed out directly in a parallel line on tape, card, or any other print output. Counter uses two sets of 4-digit print wheels (positive and negative), can print out digits ranging from 0001 to 9999. Device is rated at 9000 counts per minute, with a printing speed of 3 counts per second. Unit is basically a shaft-driven device, but can be supplied to count 720 pulses per minute. **American Data Div., American Electronics Inc.**, 75 Front St., Brooklyn 1, N. Y.

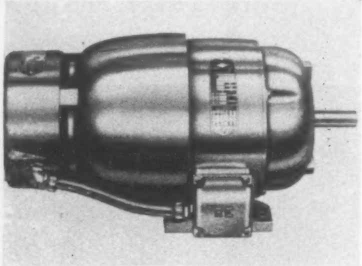
Circle 449 on Page 19

Digital Servo Indicator

Item 450

Direct reading digital counter can accurately indicate forces, fluid flow, weights, or rpm's which can be converted into ac or dc millivolt signals. Model 143 can also facilitate the measurement of any linear variable where values change throughout a wide range and where fast evaluation and good resolution are necessary. Front dimensions of the flush-mounted case are 6 by 5⅜ inches. **Gilmore Industries Inc.**, 13015 Woodland Ave., Cleveland 20, Ohio.

Circle 450 on Page 19



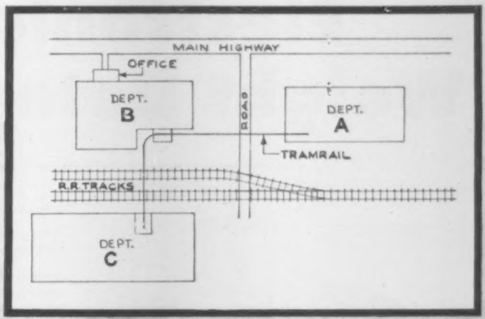
Fan-Cooled Brakemotor

Item 451

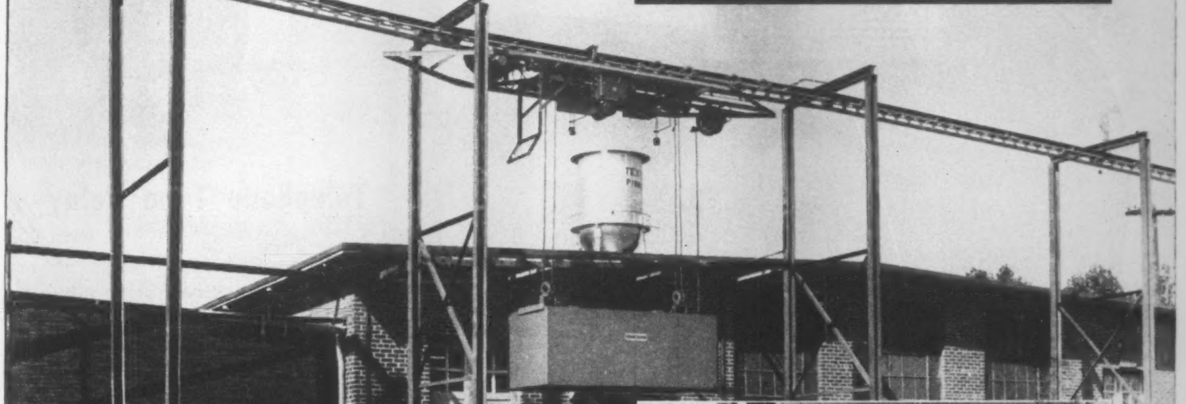
Unit is applicable in the food processing, metalworking, and materials handling industries. It features a doughnut-type magnet in the brake which allows the motor shaft to extend entirely through, allowing a totally enclosed magnetic brake and a cooling fan. The frame, endbells, cooling fan, and

Automatic Handling Between Three Buildings

Operation Costs Plunge Because of Time Saved



Photograph shows van being lowered to outside dock. It remains here until unloaded or loaded and dispatched.

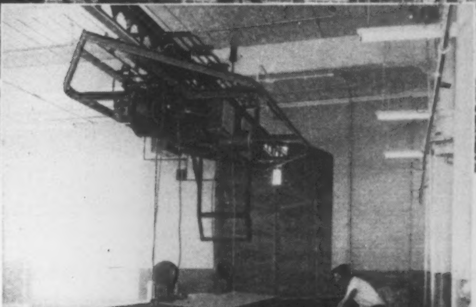


AN automatic Cleveland Tramrail materials handling system operates over a street and railroad to serve three separate buildings. It carries materials back and forth between the plants without need of especially assigned operators. The dispatching of materials is easily handled by men in the buildings along with their other work, since it is only necessary to press a push button to send a Tramrail carrier on its way.

The Tramrail carrier travels up and down grades because the buildings are at different elevations. When it reaches its destination, it lowers at once, automatically. A warning bell sounds as it descends.

Because of the time savings and elimination of need of many powered floor trucks and their expensive maintenance, cost of handling materials between the buildings is very low.

Cleveland Tramrail has engineered a wide variety of automatic materials handling systems. We stand ready to share with you the benefit of our experience.



Loading a Tramrail carrier van with four floor trucks. Each has a load of 250 lbs. Depressing the proper button on the wall sends the van to either of the other two buildings.

Write for free "Automatic Handling" booklet.

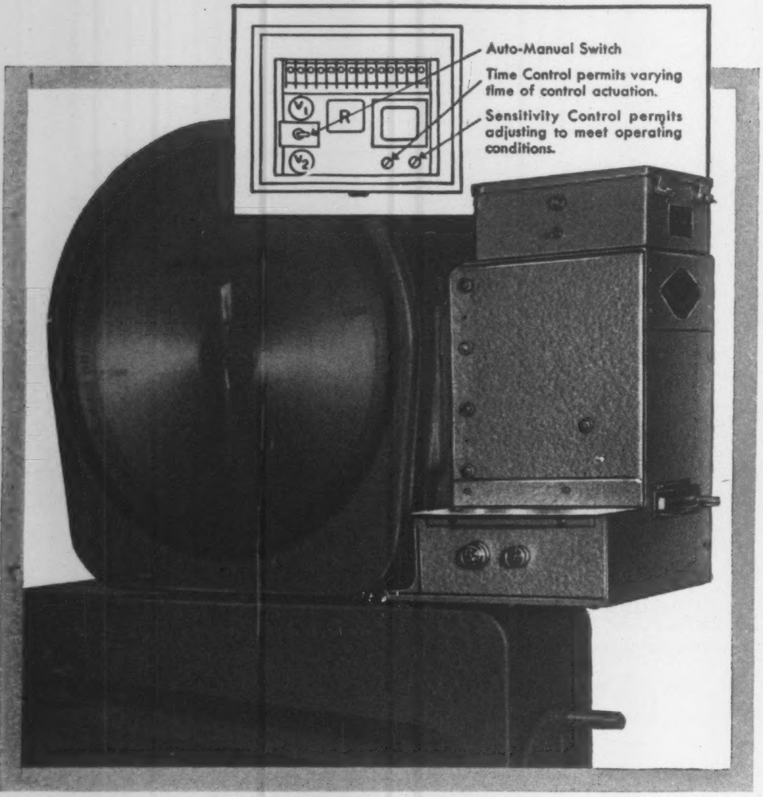
CLEVELAND TRAMRAIL

Overhead Materials Handling Equipment

CLEVELAND TRAMRAIL DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 1336 E. 290 ST. • WICKLIFFE, OHIO

Circle 695 on Page 19

NEW Fairbanks-Morse Electronic Weight Detector


Auto-Manual Switch
Time Control permits varying time of control actuation.
Sensitivity Control permits adjusting to meet operating conditions.
V1
R
V2

Prevents incorrect weighing . . . stops costly errors!

With the new Electronic Weight Detector, true weight of any load can be automatically obtained and recorded without need of a weighman. Where a weighman is used, it is impossible for him to record incorrect weights or start a sequence at the wrong time. When desired, a flip of the switch can disengage the Weight Detector entirely from the system. *This is the first fully-reliable control of its kind available in the scale industry.*

To completely automate your weighing—to be sure that your weights are correct—to protect yourself by completely policing your entire weighing operation—contact your nearby Fairbanks-Morse Field Engineer, or write directly to Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago 5, Illinois for complete information.

See Sweet's Plant Engineering File for full line of F-M Scales

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

SCALES • PUMPS • DIESEL, DUAL FUEL AND GAS ENGINES • ELECTRIC MOTORS
GENERATORS • COMPRESSORS • MAGNETOS • HOME WATER SYSTEMS

Circle 696 on Page 19

fan cover are constructed of lightweight aluminum alloy. Brakemotor is available in ratings from 1 to 30 hp and frame sizes of 182 through 326U. Drive motors are furnished in standard squirrel cage, wound rotor, or fluid shaft. **Reuland Electric Co.**, Alhambra, Calif.

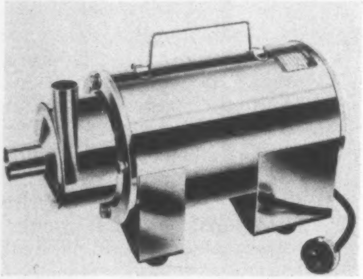
Circle 451 on Page 19

Telephone Type Relay

Item 452

Unit, rated for 5 amps at 115 v ac noninductive, is suitable for applications where limited size and weight are factors. Relay, designated Series GT, has a maximum of 6000 operations per hour. Contact pressure is 15 grams minimum; pull-in time 7 to 9 milliseconds; release time 1 to 4 milliseconds. It is available in voltages of 6, 12, 24, 110, and 230 v, either ac or dc. **Line Electric Co.**, 271 S. 6th St., Newark 3, N. J.

Circle 452 on Page 19



Stainless Steel Pump

Item 453

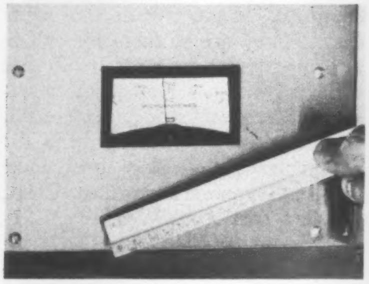
Corrosion resistant stainless steel, centrifugal pump is suitable for numerous chemical applications. Model 101 is powered by a continuous duty, 3/4 hp, single phase, 115/230 v, 60 cycle, jet pump motor equipped with automatic overload protection. Impeller design provides a capacity of 50 gpm at 20 psi. Tanks with up to 1000 gallons capacity can be easily serviced. The standard inlet is 1½-inch OD; the outlet is 1-inch OD and it can be positioned vertically or horizontally. The pumping head can be turned a full 360 degrees. **Stainless Steel Pump Co.**, 108 Wiggs St., Griffith, Ind.

Circle 453 on Page 19

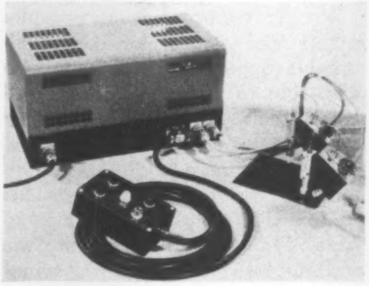
Panel Meter

Item 454

Unit is designed to fit behind the panel, with only the indicating area of the meter showing. The dial and window are slanted for easy reading and can be illuminated through a translucent rear window. The total space the meter occupies is 3½ by 2 inches. The meter is held in place by rear screw-on clamps; it does not require positioning holes for mounting studs. Sensitivity ranges of Model 361 are 0-5 microamperes to 0-50 amp and 0-5 mv to 0-500 v. **Assembly Products Inc.**, Chesterland, Ohio.



Circle 454 on Page 19



Registration Control

Item 455

Dual registration control system is a logic system which can monitor two or more sets of variables in high-speed production operations. It is applicable to multicolor printing, indexed machining, and all types of automatic assembling and channeling. The system is designed to align two sets of registration marks and also to control spacing between the marks. This makes it possible to establish a definite relationship between two moving registration marks that have no fixed point of reference such as a mechanical relationship or a time base. The system not only tells when the registration marks are aligned, when they are ahead or behind, it also corrects the situation. It is adjustable to various degrees of accuracy. A remote indicating station indicates the positions of the variables involved in a production process as well as the absence of variables. **Sterns Control Corp.**, Great Neck, N. Y.

Circle 455 on Page 19

QUICK
FLUID LINE
CONNECTION
or
DISCONNECTION

with
INSTANT
AUTOMATIC FLOW
or
SHUT-OFF

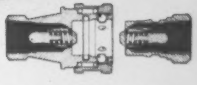
HANSEN
SERIES HK QUICK-CONNECTIVE
TWO-WAY SHUT-OFF
COUPLINGS

Hydraulic and pneumatic lines are quickly and easily connected with Hansen Two-Way Shut-Off Couplings. No tools required.

When Coupling is disconnected, valves contact valve seats in both Socket and Plug to provide instant and positive seal of fluid in both ends of line. Coupling does not depend upon line pressure to seal either end of line.

Six sizes are available, with female pipe thread connections from ⅛" to 1" respectively. Furnished either in steel or brass.

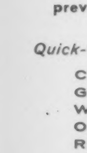
Representatives in Principal Cities ... See Yellow Pages



Instantly shuts off both sides of line... prevents loss of liquid, gas or pressure.

Quick-Connective Fluid Line Couplings for

COMPRESSED AIR • OIL
GREASE • HYDRAULIC FLUIDS
WATER • VACUUM • STEAM
OXYGEN • ACETYLENE
REFRIGERANTS • GASOLINE
COOLANTS • LP-GAS



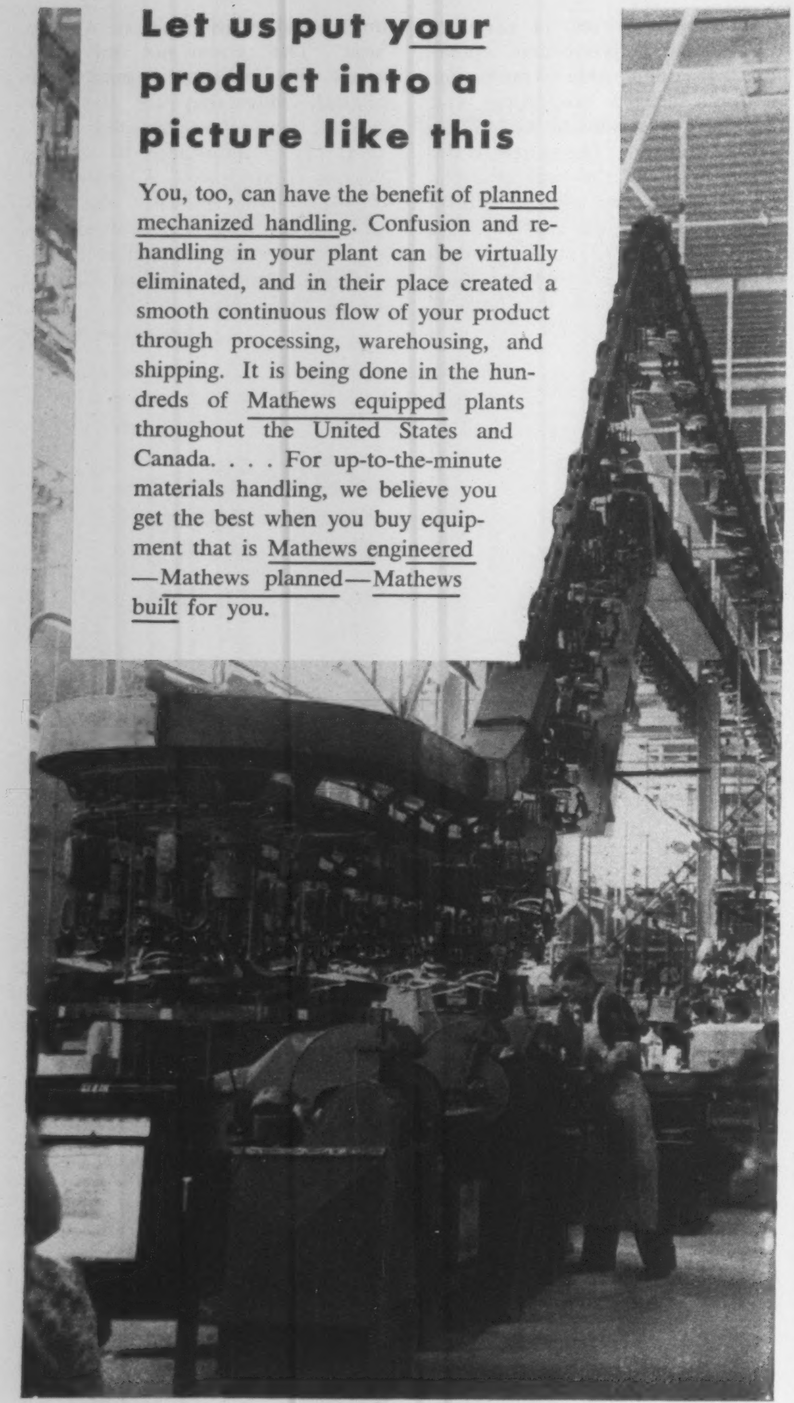
Write for the Hansen Catalog

Here is an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings.

SINCE 1915 QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY
4031 WEST 150th STREET • CLEVELAND 35, OHIO

Circle 697 on Page 19



Let us put your product into a picture like this

You, too, can have the benefit of planned mechanized handling. Confusion and rehandling in your plant can be virtually eliminated, and in their place created a smooth continuous flow of your product through processing, warehousing, and shipping. It is being done in the hundreds of Mathews equipped plants throughout the United States and Canada. . . . For up-to-the-minute materials handling, we believe you get the best when you buy equipment that is Mathews engineered—Mathews planned—Mathews built for you.

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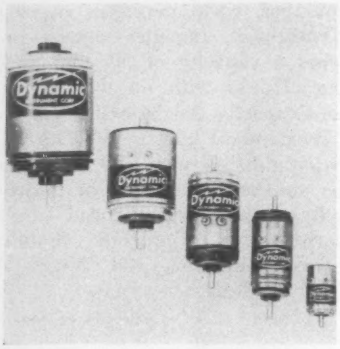
CANADIAN DIVISION . MATHEWS CONVEYER COMPANY, LTD., PORT HOPE, ONTARIO.

MCC MATHEWS

Over Fifty Years of Leadership in Mechanized Handling

Circle 698 on Page 19

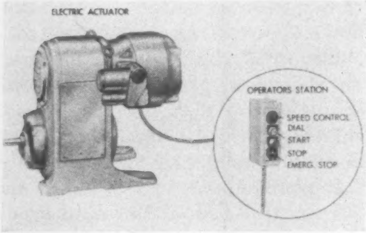


Clutches & Brakes

Item 456

Line of magnetic clutches and brakes consists of nine models in five frame sizes (from 5 to 18), with torque ratings ranging from 6 oz-in. to 224 oz-in., and with power consumption ranging from 2.5 w to 5 w. They are suitable for use in analog computers and servo and control systems. The magnetic design of the units is such that it does not load the bearings, thus the design leads to a low breakaway torque. **Dynamic Instrument Corp.**, 59 New York Ave., Westbury, L. I., N. Y.

Circle 456 on Page 19



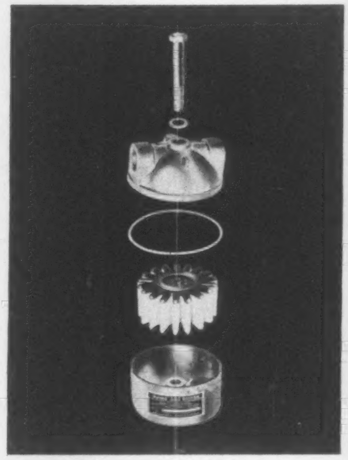
Adjustable Speed Control

Item 457

Electric control system provides remote dial control for company's variable speed motors. It is also adaptable to other automatic control systems, especially those using a potentiometer type pick-up. Device consists of a control unit; an operator's station which houses the graduated speed control dial and *Start*, *Stop* and *Emergency Stop* pushbuttons; and an electric actuator motor and shifting mechanism which physically causes the unit to change speeds.

Speed of the drive can be preset before starting. Under normal stop conditions, the electric control automatically returns the drive to low speed. As a safety precaution, the *Emergency Stop* button provided eliminates the return to slow speed. **U. S. Electric Motors Inc.**, Box 2058, Terminal Annex, Los Angeles 54, Calif.

Circle 457 on Page 19

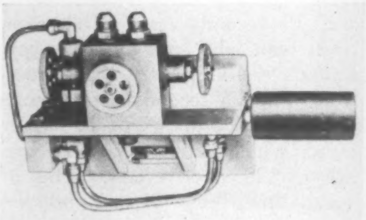


Compressed Air Filter

Item 458

Filter is constructed with a die cast aluminum base and head, consists of 6 parts assembled by a single bolt, washer, and gasket. Model CPHB-5D has a capacity of 600 scfh with initial pressure drop of 1 inch of water; design pressure is 125 psi. Over-all dimensions are 5¼-inch high and 4½-inch in diameter; inlet and outlet pipe connections are ¾-inch or 1-inch standard female. It is recommended that installation should be located on the compressed air piping, as near to the point of usage as possible. **Dollinger Corp.**, Rochester 3, N. Y.

Circle 458 on Page 19



Linear Transmitter

Item 459

Instrument can pneumatically transmit measurements of full scale

ALL NEW . . . through and through!

New
POSITIVE CONTROL CLUTCH
New
HOPPER DRIVING MECHANISM
New
FEED TRACK AND ESCAPEMENT MECHANISM
DETROIT

*Also available as a self-contained driving head for use in specially designed assembly machines.

The DPS model U power screwdriving machine

Manufacturing assemblies with small parts? Take note! Detroit Power Screwdriver Company announces the totally new Model U—quickly adaptable for fast, clean driving of screws, nuts and studs.

Scores of advances! An adjustable clutch designed to hold constant driving torques. A hopper drive with built-in slip control to accommodate shock loads. A feed track with quickly adjustable covers, and an escapement mechanism with positive solenoid action permitting release of screw by body or head.

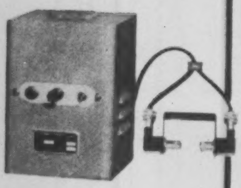
A new folder, too. Write for your copy today.

DETROIT POWER SCREWDRIVER COMPANY 15,033
2811 W. Fort St. • Detroit 16, Michigan
A Subsidiary of Link-Belt Company

Circle 699 on Page 19

POST DECITRON ELECTRONIC PRODUCTS

Photoelectronic Controls

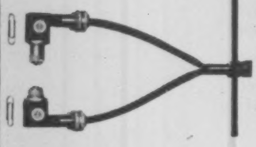


Model K-1 with Miniature Photohead

This is a general purpose photoelectric control whereby the interruption of a light beam in the photohead closes a relay which can be used to activate an external circuit.

Model K-3

The K-3 control differs from the K-1 in that the output relay will not energize for each interruption of the light beam, but only if interruptions cease. Can be used to detect "flow" stoppage.



Model H-21-C

The compact, long life, *miniature* photohead . . . ideal for mounting in limited space. May be furnished with alignment brackets to insure proper relation of light source and receiver.

Decitron

ELECTRONIC PRODUCTS DIVISION

Post Machinery Co. | 159 Elliott St., Beverly, Mass.

Circle 700 on Page 19

ACRO WELDER MFG. CO.

MILWAUKEE

WELDING ENGINEERS

MACHINERY BUILDERS

ESTABLISHED 1936

Circle 701 on Page 19

POSITION WANTED

INDUSTRIAL PROMOTION CONSULTANT will write and place product stories in leading trade journals. Articles ghosted. Professional ad copy. Fast, reasonable.

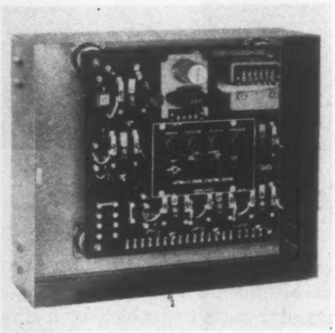
SIEGEL ORGANIZATION, 11 Buckingham Court, Maywood, New Jersey.

Use an Inquiry Card

For further information on anything described or advertised in this issue . . . . SEE Page 19

pressure differences up to 300 psi. Suitable applications include measuring pressure drop across a superheater, between steam header and turbine throttle, across high pressure heat exchangers, between stages of high pressure multistage hydraulic pumps, or as a square root flowmeter when the pressure difference is very high. In operation, the pressure transmitter receives two input pressures and converts the difference to a single output pressure directly proportional to the difference. The instrument can be used at static pressures up to 3000 psi. **Controls Div., Hagan Chemicals & Controls Inc.,** Box 1346, Pittsburgh 30, Pa.

Circle 459 on Page 19

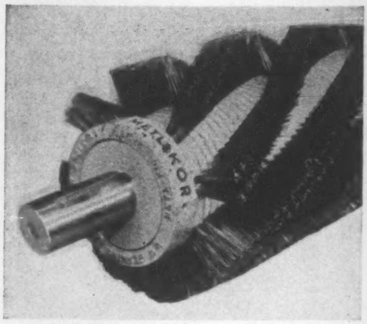


Engine Control

Item 460

Automatic device is capable of starting and stopping engine driven sets under the control of an *On-Off* control device. The control device can be a contact on the automatic transfer switch panel which closes when normal power fails; a toggle switch; or a temperature or pressure device. A synchronous motor driven timer provides an adjustable number of cranking cycles (1 to 4) of 10 seconds crank and 10 seconds rest. This same timer can also provide one continuous cranking period adjustable from 5 to 75 seconds. The motor driven timer is powered by an inverter which converts battery voltage to 120 v, 60 cycles. This inverter-timer combination provides constant cranking periods despite wide variations in battery voltage and ambient temperature. **Automatic Switch Co.,** Florham Park, N. J.

Circle 460 on Page 19

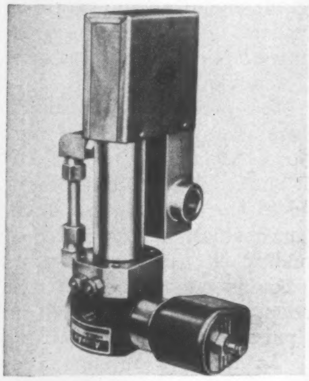


Conveyor Cleaning Brush

Item 461

Device automatically removes particles or chips of food, chemicals, tobacco, metals, coal, stone, wood, or plastics from conveyor belts made of fabric, metal, or rubber. Spiral (shown) or rotary brushes are available for intermittent or continuous duty. The brush can be easily installed on a conveyor or adjacent operating equipment. The bristles in the brushes are made to resist the corrosive effects of acids, alkalies, etc. **M. W. Jenkins' Sons Inc.**, 444 Pompton Ave., Cedar Grove, Essex County, N. J.

Circle 461 on Page 19



Vacuum Valve

Item 462

Line of pneumatically operated vacuum valves is of brass bellows-sealed construction, ranging in size from 5/8 to 1½-inch port size. Designated type PV, the valves are available for either right angle or in-line applications, can be mounted vertically or horizontally. Large stroke, short-flow path through the valve, and an unobstructed full size port provides high conductance. The

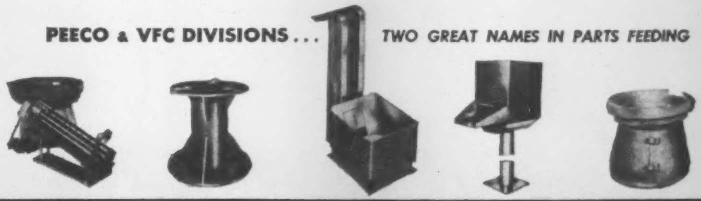
PACKAGED
AUTOMATION!

Achieve efficient, automatic production, and produce more all along the line, by integrating equipment designed and built by AUTOMATION for automation.

For example, vibratory parts feeders perform more efficiently on an engineered base permitting maximum power transmission. Either the side delivery or the elevating conveyor supply hoppers (with automatic paddle type relay switch to regulate delivery) hold large quantities of parts and are real labor savers. These are just a few advantages that make automation work and pay for itself.

You can depend on the proven talents at AUTOMATION DEVICES, INC.—enlist their help. Write today for the informative bulletin on "Packaged Automation."

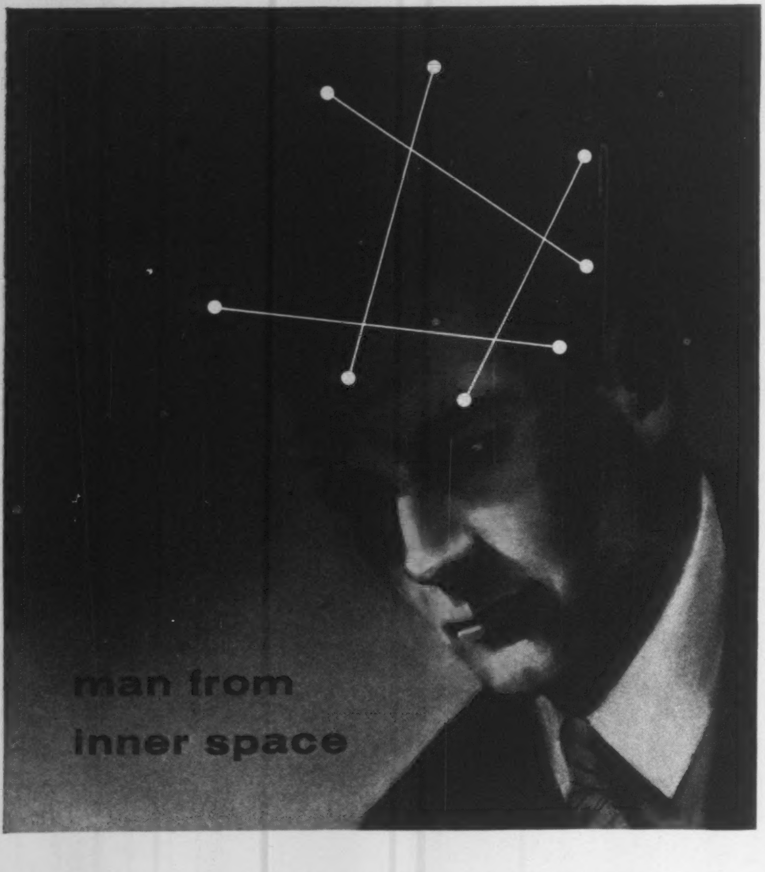
PEECO & VFC DIVISIONS . . . *TWO GREAT NAMES IN PARTS FEEDING*



AUTOMATION DEVICES INC.

ERIE, PENNSYLVANIA

Circle 702 on Page 19



Outer space has its problems and its specialists. But for those concerned with moving things through the *inner* reaches of a plant or factory, there is no better source than "The Man from Logan."

As your field engineer for Logan Conveyors, he must qualify with a strong academic background, years of home-office and field engineering work, and a good command of Logan's two generations of experience as a leading conveyor company.

In addition to these personal qualifications, "The Man from Logan" calls on any assistance needed from a progressive research and development staff and an eminently qualified home-office engineering force. And, of course, Logan's resources of materials and components are unsurpassed in the industry.

To you, then, "The Man from Logan," comes as the convenient and completely dependable source for the one best custom-designed conveyor system for any need. You need only to call him in. His broad experience further assures you that costs will be kept as low as is feasible. Write or phone today for a visit from "The Man from Logan."

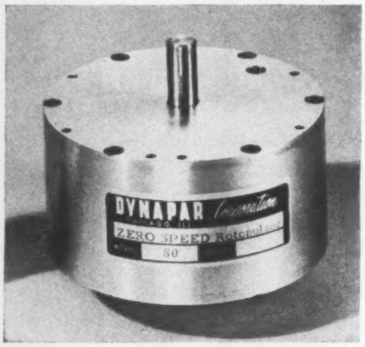
Logan Conveyors

LOGAN CO., 218 CABEL ST., LOUISVILLE 6, KY.

Circle 703 on Page 19

110 v coil failsafe solenoid pilot valve, supplied with the Model PV valve, will automatically move to close in case of electrical power failure. Air requirement for this valve is 15 to 75 psi. **Veeco Vacuum Corp.**, Dept. 1297, 86-P Denton Ave., New Hyde Park, L. I., N. Y.

Circle 462 on Page 19



Rotation Transducer

Item 463

Transistorized, add-subtract unit is designed for linear or angular positioning applications such as digital machine tool positioning, precision cutting-to-length, and welder electrode positioning. It can be used with digital process controllers or totalizers to provide direct-reading numerical indication plus actuation of various control functions when the preset add or subtract numbers are reached. Speed range of Model 82 is from zero to 2000 rpm. The equipment can be connected to measuring wheels to convert mechanical motion into corresponding electrical pulses—up to 1200 counts per rotation in either direction. Inside the sealed unit is a pulse disc and a silicon light cell. As the disc rotates in one direction, a beam is broken, generating pulses to the control equipment; similarly, pulses are fed on a separate wire when the disc rotates in the other direction. Output is negative 15 v pulses. **Dynapar Corp.**, 5150 Church St., Skokie, Ill.

Circle 463 on Page 19

Time Delay Relay

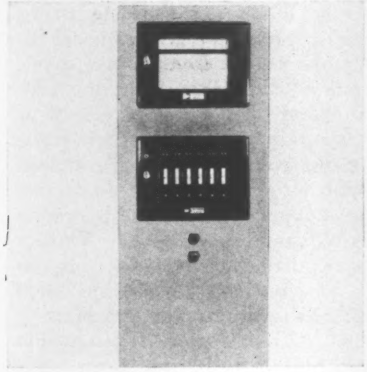
Item 464

Miniature device is unaffected by voltage variations, features instan-

AGASTAT
TYPE
2112-D-H1
COIL
28V DC
RANGE
.030-10 SEC.
SETTING
3 SEC.
SERIAL NO.
M 500
AGA

taneous recycling. The timing range can be adjusted to a time-setting as low as 30 milliseconds with a repeat accuracy of 5 per cent. Three timing ranges are available covering from 0.030 sec to 2 min. The unit can be supplied for delay on energizing or de-energizing; coils in a range of voltages are available for ac or dc circuits; double pole double throw single break contact arrangements and hermetically sealed or dust-tight housings with octal-plug, solder lug, or AN connector terminals are offered. **AGA Div., Elastic Stop Nut Corp. of America,** Elizabeth, N. J.

Circle 464 on Page 19

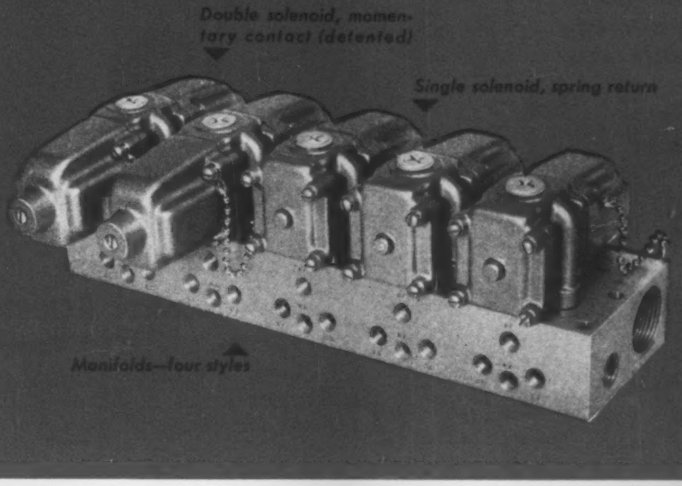


Recorder-Controller

Item 465

Combination, multipoint recorder and controller is capable of controlling up to six points and recording up to 24 points. It can operate from either one or two separate thermocouples or other inputs per point. The use of dual inputs provides positive protection against failures of either half of the system. Proportional or *On-Off* electric control is available. Pneu-

NOW A COMPLETE FAMILY OF SMALL AIR VALVES, MANIFOLDS, ACCESSORIES


Double solenoid, momentary contact (detented)
Single solenoid, spring return
Manifolds—four styles

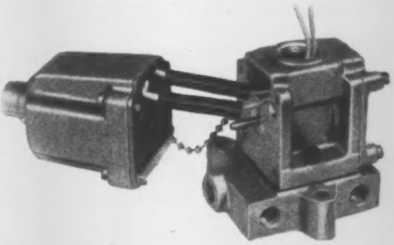
NUMATICS' New SA Junior Series

You've found it! . . . the answer to *all* your small air valve requirements. It's the new *SA Junior* Series . . . Numatics' small, precision-built, heavy duty family of valves and manifolds. Two valve types (above), many model varieties . . . three different sub-plates . . . three operator options and four styles of manifolds to provide application versatility unlimited.

SA Junior, what's more, gives you *quality* throughout . . . Numatics' famed patented lapped spool-floating sleeve action . . . corrosion-resistant aluminum body . . . continuously rated, heavy duty solenoids . . . J. I. C. conformance . . . all this plus a ruggedness and reliability to handle 60% of all your air jobs at an average 40% reduction in air valve costs. Send for a catalog today!

"Solenoid Capsule" Design—Another NUMATICS' FIRST!

Typical of SA Junior quality and design ingenuity is the unique, new "Solenoid Capsule" . . . a Numatics' *exclusive.* Solenoid and cover are a self-contained, J. I. C. approved assembly which eliminates loose parts when the solenoid cover is removed.



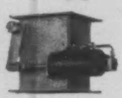
NUMATICS, Inc.
HIGHLAND, MICHIGAN

Circle 704 on Page 19

UNITIZED
WEIGHER-FEEDER

Building-block design gives custom-made utility at an off-the-shelf cost

A



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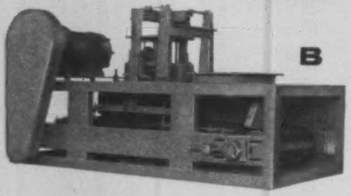

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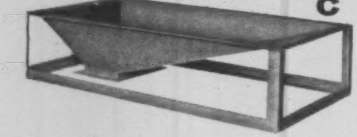


UNITIZED construction makes the W-C Weigher-Feeder readily adaptable to practically any processing setup. Components are standardized, proven and interchangeable . . . pre-engineered with virtual "plug-in" simplicity.

A The UPPER FRAME controls material input, is supplied with a rotary feeder, sliding gate, vibratory feeder or other mechanism matched to material and flow requirements.

B The CONVEYOR FRAME, where material is weighed, includes a complete conveyor section, weighing pan and transmitter with integral tare adjustment. W-C's system of flexure mountings assures accurate measurement despite uneven loading or pile-ups. There are no knife-edges, beam pivots or other points of concentrated wear to affect accuracy.

C The LOWER FRAME is optional; can be a simple chute as shown.

In addition, the W-C Weigher-Feeder is designed to handle such instrument-controlled functions as flow totalizing, recording, programming, and material proportioning. Units are also available for installation on existing conveyors.

Complete information is given in Catalog 12. Write for a copy

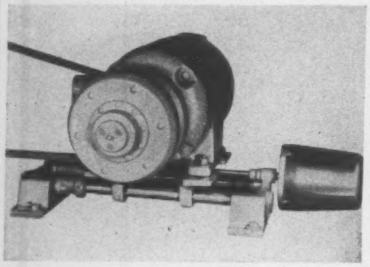
W-C

S.A. 1667

WEIGHING and Control COMPONENTS, Inc.
206-C Lincoln Ave., Hatboro, Pa.
Circle 705 on Page 19

matic control can be supplied by the use of electropneumatic converters. **Daystrom-Weston Industrial Div., Daystrom Inc.**, 614 Frelinghuysen Ave., Newark 12, N. J.

Circle 465 on Page 19

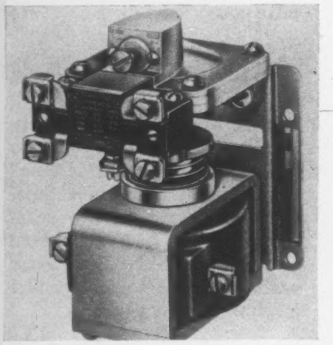


Remote Control Actuator

Item 466

Rotary actuator for sliding motor base drives is suitable for remote and automatic control of industrial equipment such as variable speed drives, valves, pumps, reactors, and machine tools. Model SM-18 has a built-in precision potentiometer which is gear connected to the output shaft through a wide choice of ratios so that from 1/6 to 40 shaft revolutions correspond to full scale control. Unit is available with ratings to ¾ hp in single and three phase styles with 500 w units offered in two phase, servo types. A typical unit delivers 200 lb-in. at 50 rpm. **Jordan Co.**, 3235 W. Hampton Ave., Milwaukee, Wis.

Circle 466 on Page 19

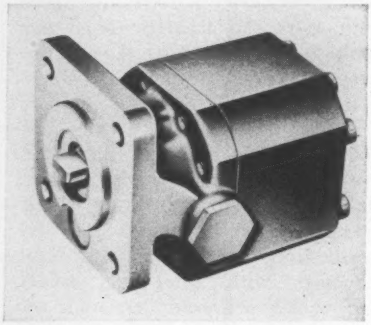


Time-Delay Relay

Item 467

Designed for dc operation, pneumatic time-delay relay is rated for pilot duty applications up to a maximum of 600 v. It has an adjustable timing period of from 0.2 second to one minute. Type H is designed as a companion to company's Type A ac timer. Both units have identical mounting hole dimensions and are available for either on-delay or off-delay operation. An invertible magnet structure permits in-the-field conversion from one form of operation to the other. **Square D Co.**, 4041 N. Richards St., Milwaukee 12, Wis.

Circle 467 on Page 19



Piston Pump

Item 468

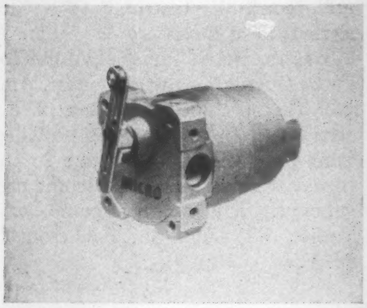
Lightweight piston pump features a built-in charging gear pump. It can be used as a metering pump with a variable delivery device to vary the output from zero to maximum, or it can be run continuously to charge the accumulator of a heavy duty hydraulic instant starting system for engines and turbines. It can also be used with dual pressure to operate a portable hydraulic high compression tool. Various piston diameters provide from 10 to 50 cipm at pressures to 4000 psi; the gear section provides ½ gpm at 1800 rpm. **Constant-Flo Div., John S. Barnes Corp.**, 301 S. Water St., Rockford, Ill.

Circle 468 on Page 19

Weather Resistant Switch

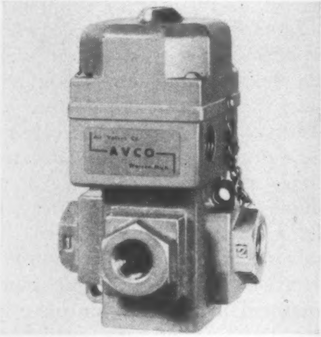
Item 469

Device is adaptable for use on industrial valve control systems, pipelines, pumping stations, fuel handling devices, and other hazardous outdoor installations. Designated the CX Series, unit is rated for 20 amps, 125, 250, or 460 v ac and 10 amps, 125 vac for tungsten



filament lamps. Switch has a stainless steel lever arm with a nonsparking roller. Arm is field adjustable through 360 degrees and can be varied from 1-inch to 3½ inches in length. Two enclosed single-pole, double-throw units can be wired double-throw, normally open or normally closed. Roller arms are moved clockwise to actuate one unit, counterclockwise to actuate the other unit. **Micro Switch, Div., Minneapolis-Honeywell Regulator Co.,** Freeport, Ill.

Circle 469 on Page 19



3-Way Valve

Item 470

Unit is designed to operate as a 2-way or 3-way valve either normally open or closed to pressure. The balanced spool type unit can be used as a selector valve, as a directional valve, or in vacuum circuit applications. It is also suitable for use in conjunction with 4-way valves for dual schedule resistance welding applications. Valve is available for single or double solenoid operation or for single or double pilot operation. Sizes range from ¼ to ¾-inch pipe. **Air Valves Co.,** 24581 Groesbeck Hwy., Warren, Mich.

Circle 470 on Page 19

POSITIVE FILTRATION

(TO ½ MICRON) FOR AS LITTLE AS

.00015¢ PER GALLON!

AND IT'S COMPLETELY AUTOMATIC!

Now, from Olson, a new dimension in industrial filtration — the first completely automatic, pressure-type filter! Every cycle — precoat, run, backwash—is automatically controlled. Injection of filter-aid (when used) and sludge carry-out are also automatic.

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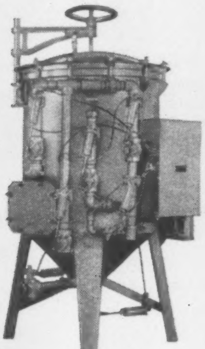
In large central systems, or with individual machines, Olson Filters guarantee over 96% purification of all types of coolants, cutting oils, quenching oils, cleaning and washing solutions and other industrial solvents at the lowest cost per gallon.

By the way, what are *your* costs per gallon? Why not check and see? Then call Olson.



The new Olson Industrial Filter is available in 8 standard models, from 10 gpm to 600 gpm capacities.

Write for free catalog on the new Olson automatic pressure-type filter.

OLSON FILTRATION ENGINEERS
Division of The American Laundry Machinery Company
DEPT. A, CINCINNATI 12, OHIO

Circle 706 on Page 19

ELECTRONICS: Over, on and under...

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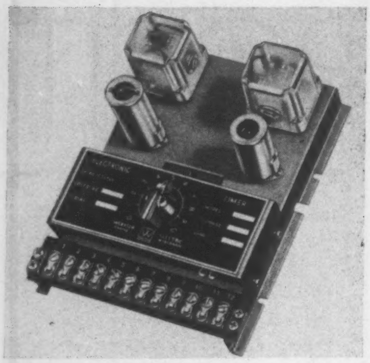
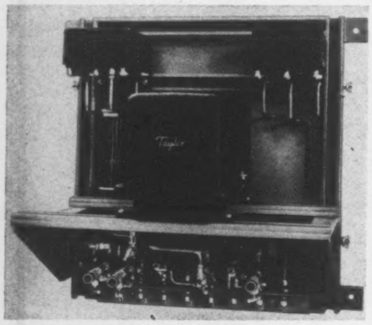


Electronic Timer

Item 471

Device is suitable for interval, delayed action, repeat cycle, or two sequence operation of processes and machines. Model Tl can be used for continuous cycle operations which are turned on or off for a given period, with the cycle continuous until the initiating switch is opened. Timer requires no warm-up time; the cold cathode type tubes respond immediately upon demand. If remote operation is desired, the dials and control knobs can be removed and relocated at a remote control point. Unit is rated for 105-125 v ac, 50-60 cycles. Time ranges are from 0.3 to 25 seconds to 0.5 to 50 seconds. **Webster Electric Co.**, Racine, Wis.

Circle 471 on Page 19

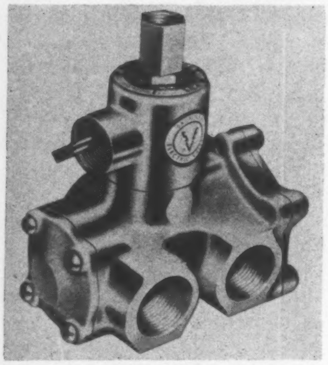


Computing Controller

Item 472

Single analog computer is capable of measuring and controlling the internal reflux flow from the top plate of a fractionating column. Peripheral measurements combined with predetermined mathematical computations provide accurate internal reflux flow rate measurement and control. Instrument is designed to compensate for climatic effects on the reflux system and for cyclic fluctuations which occur. Ample time for the correction of external reflux flow rates is provided before the effects of change in internal reflux flow rates become significant. **Taylor Instrument Companies**, 95 Ames St., Rochester 1, N. Y.

Circle 472 on Page 19



Three-Way Valve

Item 473

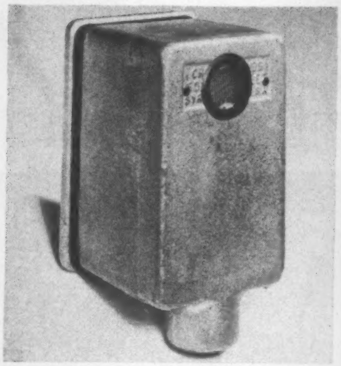
Line of solenoid valves, designated the L3 Series, can control media such as oil, air, water, inert gases, kerosine, and gasoline. They are applicable for chemical process equipment, presses, water treatment equipment, industrial machinery, packaging machinery, and air and hydraulic cylinders. The valves operate on a pressure differential of 5 to 150 psi, can be mounted in any position directly to the line. They are available in 3/8, 1/2, and 3/4-inch orifice size, normally open or normally closed. The bodies are constructed of naval forged brass and the internal parts of stainless steel and brass. **Skinner Electric Valve Div.**, Dept. LL149, 105 Edgewood Ave., New Britain, Conn.

Circle 473 on Page 19

Photorelay

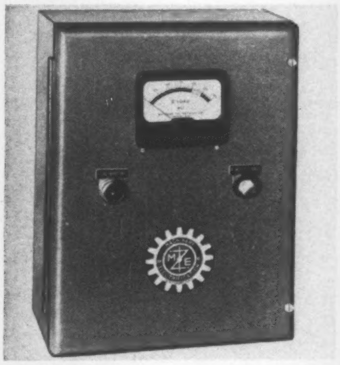
Item 474

Unit incorporates a solid-state photocell, can automatically trigger *on-off* and *go-no-go* circuits at predetermined light levels. It is suitable for control, measuring, and safety functions. Constructed to



withstand the effects of dust, moisture, shock, and vibration; Model R-CH is mounted in a condulet box with a ½-inch threaded fitting. Unit is sensitive to 10 ft-c, operates on 60 cycles, 115 v ac. It uses single-pole, single-throw relay contacts rated at 5 amp at 115 v ac. Power consumption is 2.5 w. **Berkeley/Dynamics**, 2831 7th St., Berkeley, Calif.

Circle 474 on Page 19



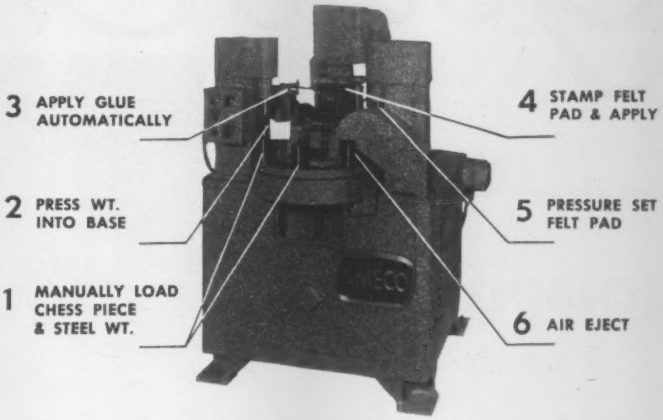
Electric Load Control

Item 475

Load control, designated Model MEK-3657, automatically adjusts itself during set-up to correct load settings and protect against overloads. In operation, when the unit is applied to a machine or process, the set-up man snaps the switch to *Calibrate* position. When the machine is running in the proper manner, the switch is returned to the *Run* position. If process requirements change, the procedure is repeated and the control will adjust itself to the new condition. **Machinery Electrification Inc.**, 36 Hudson St., Northboro, Mass.

Circle 475 on Page 19

AUTOMATIC ASSEMBLY MACHINE FOR CHESSMEN



We invite your inquiries on automatic assembly machines, automatic transfer devices and automatic inspection and measuring equipment.

Our services include the design and development of equipment incorporating electronic and mechanical techniques.

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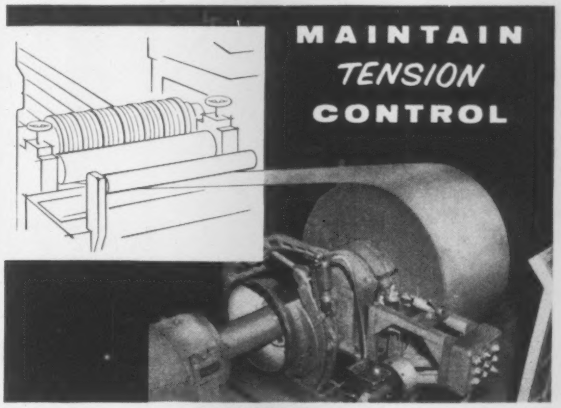
Circle 707 on Page 19



with Wagner Actuating System and Brakes

Now, you can keep easily adjustable tension on heavy rolls used in steel slitting operations—in handling paper, and in other similar applications. Wagner Industrial Brakes maintain tension on the rolls and permit emergency machine stops, while Wagner Actuating Systems provide smooth, manually operated control. In the steel slitting machine installation shown above, a regulating valve is used to establish the amount of tension required for various materials and gage thicknesses. A hand operated application valve is used to apply or release the roll tension during set-up and operation.

Your nearby Wagner field engineer will develop detailed specifications to meet your special application. Call him today.

157-3

Wagner Electric Corporation
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Circle 708 on Page 19

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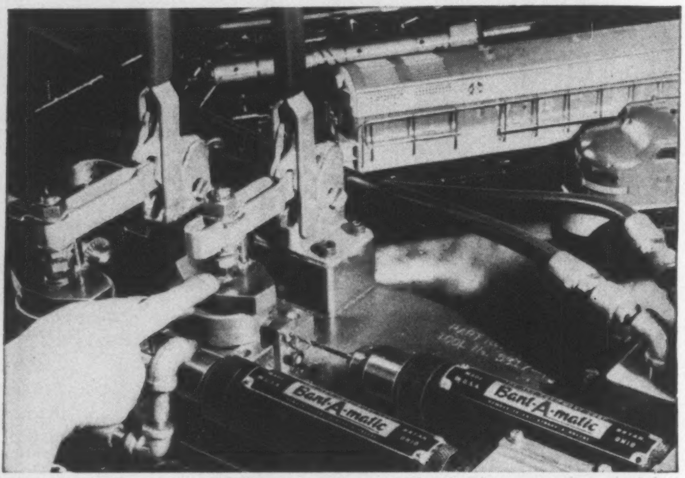
You do it!



YOU DO IT—using ARO components! That's the way the makers of Lionel trains automated drilling. They used ARO Bant-A-matics and accessories . . . installed by their own plant men.

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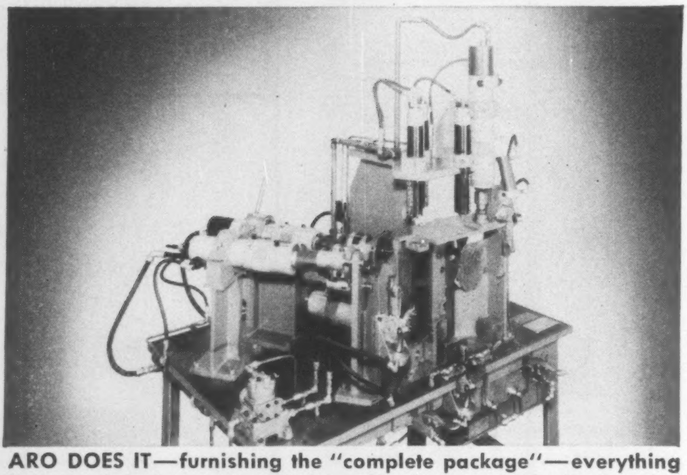

ARO DOES IT—furnishing the "complete package"—everything from engineering to installation. That's how ARO Automation solved this problem for a maker of automotive parts.

DRILL, TAP, FASTEN *faster*
with

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AUTOMATION AIR TOOLS

Name your problem in drilling, tapping or fastening . . . ARO can show you a simple way to solve it and step up production!

SINGLE OR MULTIPLE SET-UPS . . . air operated units for widest range of applications. Choice of 4 sizes. Capacities up to ¾″. Minimum center to center distance 1″.

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catalogs and literature

Latest automation information. For copies use card on page 19.

Electromagnetic Relay Papers

Potter & Brumfield, Div., American Machine & Foundry Co., Princeton, Ind.—134 *page handbook*—Papers from the Seventh Annual Conference on Electromagnetic Relays are contained in Bulletin 13C075. Included are reports on simplified monitoring circuits for contact life tests, monitoring relay life tests, evaluating rf interference properties of relays, single pulse operation of relays, and vibration testing of relays. In all, 31 papers are presented.

Circle 476 on Page 19

Turret Drilling Machine

Brown & Sharpe Turret Drilling Div. Inc., 20 Fitch St., East Norwalk, Conn.—20 *page booklet*—Turret drilling machine and work-positioning tables are described in Catalog 1T. It is explained how six spindles work on a single axis so that tools for drilling, tapping, boring, or reaming can be indexed in any sequence and locked into alignment with the main drive spindle. Work-positioning without the use of guide bushings or box jigs is also covered. Illustrations show details of the turret head, speed, depth, and tapping controls.

Circle 477 on Page 19

Grinding Gages

Federal Products Corp., 1144 Eddy St., Providence 1, R. I.—16 *page booklet*—Line of continuous grinding gages is described in Catalog 59A. Included are data on a miniature OD grinding gage for diameters below a ½-inch; a king-size OD gage for diameters over 20 inches; and a gage for continuously measuring ID while grinding. Details are given on the interchangeable components of the gage.

Circle 478 on Page 19

Spring Clutches

Marquette Div., Curtiss-Wright Corp., 1145 Galewood Dr., Cleveland 10, Ohio—27 *page catalog*—Data are given on five lines of spring clutches in bore sizes from ⅛ to 1-inch and torque capacity up to 1250 pound-inch. They are suitable for use in machinery, equipment, and instrument applications using drives up to 5 hp. Types of units described include: Overrunning and backstopping, indexing, on-off, and on-off indexing. Notes are included for selecting the correct type and size of each series.

Circle 479 on Page 19

Conveyor Products

Diamond Chain Co. Inc., Subsidiary of American Steel Foundries, Indianapolis 7, Ind.—104 *page catalog*—Data are contained in Catalog 759 on line of power transmission and conveyor products. Included in the line are standard roller chains of regular steel, stainless, and bronze; nonstandard roller chains; heavy series roller chains; light series roller chains; conveyor chains; and sprockets. Specification charts are given and illustrations show the features of the different items.

Circle 480 on Page 19

Hydrostatic Instruments

Petrometer Corp., 43-22 Tenth St., Long Island City 1, N. Y.—88 *page handbook*—Booklet entitled "Handbook of Hydrostatic Instrumentation" contains information on the principle of hydrostatic measurement, selection and installation of instruments, and the design and construction of panel systems. Details are given on liquid level indicators, fuel oil indicators, dial indicators, specific gravity indicators, pneumatic manifold valves, and safety cleanout valves. Tank volume formulae, conversion tables, viscosity charts, and hydrometer scales are listed.

Circle 481 on Page 19

Water Treatment Control

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio—8 *page bulletin*—Bulletin W18.1-2 contains a report describing control of a treatment plant for boiler feed water. Details are presented on how instrumentation and automatic controls were applied to the plant. Schematic diagram and chart records are given.

Circle 482 on Page 19

Gear Drives

Industrial Products Div., Western Gear Corp., P. O. Box 126, Belmont, Calif.—20 *page booklet*—High speed drives suitable for special test stands, industrial applications, pipeline and air conditioning service are described in Bulletin 5904. Outline dimensions are given and tables list ratio factors, service factors, and horsepower ratings. Data are also given on special units with ratings up to 50,000 rpm and 50,000 hp.

Circle 483 on Page 19

Induction Voltage Regulators

Voltage Regulator Product Section, General Electric, Pittsfield, Mass.—60 *page catalog*—Data are contained in Catalog GEC 1450A on line of dry type and liquid filled voltage regulators for 60 and 400-cycle applications. The dry type single-phase units are furnished in ratings up to 180 kva, 600 v and below, three-phase up to 720 kva. Liquid filled units are rated up to 2200 kva, 13,800 v and below. Performance charts and connection diagrams are given. The importance of proper voltage control and the effects of poor voltage regulations are discussed.

Circle 484 on Page 19

Lubricants

Alpha-Molykote Corp., 65 Harvard Ave., Stamford, Conn.—4 *page pamphlet*—Details are given in Bulletin 121 on selecting the proper lubricant for almost any extreme pressure lubrication job. Selector charts evaluate the types of lubricant based on temperature, environment, method of application, incorporation into common materials, and recommendations for various parts, operations, and conditions. Technical descriptions of the various types of lubrication are also given.

Circle 485 on Page 19

Instrumentation Equipment

Hays Corp., Michigan City, Ind.—8 *page bulletin*—Instruments for pressure, flow, temperature, level, and gas analysis are outlined in Bulletin 59-C091. Data are also given on receivers such as recorders, indicators, and retransmitters. Notes are included on all-electric combustion control systems, which are co-ordinated with boiler room instrumentation.

Circle 486 on Page 19

Resistance Welders

Sciaky Bros. Inc., 4915 W. 67th St., Chicago, Ill.—8 *page bulletin*—Two welding units are covered in Bulletin 318-1; Type SPT-2, a spot welder and Type EPT-2, a projection welder. Both machines are the press type, air operated, three-phase design. Details are given on the three-phase principle of operation, aided by wiring diagrams and oscillograms.

Circle 487 on Page 19

Synchro and Resolver Testing

Theta Instrument Corp., 48 Pine St., East Paterson, N. J.—25 page handbook— Data are given on electrical parameters for control synchros and resolvers. Details are given on the techniques of control synchro and control resolver testing; also details on the test procedure and application factors associated with electrical zero, electrical error, fundamental null, total null, transformation ratio, and phase shift.

Circle 488 on Page 19

Shape-Cutting Machine

*Linde Co., Div., Union Carbide Corp., Room 2840, 420 Lexington Ave., New York 17, N. Y.—8 page bulletin—*Shape-cutting machine that can automatically reproduce metal parts from exact size pencil drawings is described in Bulletin F-1294. Features of the panel board, which controls all machine functions from the operator's seat, are given. Also explained is principle of operation of the cutting torches which can flame-cut intricate parts of any length, width, or thickness.

Circle 489 on Page 19

the Modern Way

FAST, AUTOMATIC CUT-OFF of TUBING and BAR STOCK

with automatic loading, combined with forming, grooving, flanging or chamfering in a single operation!

The illustration shows the Modern Automatic Cutting-Off Machine, equipped with automatic feeder which holds up to 100 bars of 3" stock. Stock can be random lengths, which are fed, measured, trimmed and cut.

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The cost savings made possible by combining these operations merit your serious consideration. If you have to cut tubing or round bar stock — particularly with grooves or forming required near the ends — send your prints for our recommendations.

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New catalog describes all models—gives production figures. Mailed on request.

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MODERN MACHINE TOOL CO.

2005 Losey, Jackson, Michigan

Lubrication for Chain Drives

*Sun Oil Co., Industrial Products Dept., 1608 Walnut St., Philadelphia 3, Pa.—4 page pamphlet—*Principles of lubrication, maintenance, and oil selection are covered in Bulletin 54 entitled, "Lubrication of Roller and Silent Chain Drives." Points discussed include general maintenance and how to classify the speed of chain drives.

Circle 490 on Page 19

Mercury Switches

*Micro Switch, Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.—12 page booklet—*Line of mercury switches, suitable for ac or dc applications, is described in Catalog 90b. Types of switches include: General-use, low-angle, small-size, pulse, heavy duty, and enclosed design styles. Mounting and actuation methods are described and data are given on mounting clips.

Circle 491 on Page 19

Weighing Systems

*A. H. Emery Co., Pine Street, New Canaan, Conn.—8 page bulletin—*Five types of 5000-lb capacity weighing cells and the instrumentation that can be used with them are described in Bulletin 591. Basic principles of the weighing system using the weighing cells are explained and schematic diagrams show the structure of the different models. Prices are also listed.

Circle 492 on Page 19

Automatic Deburring Machines

*Acme Mfg. Co., 1400 E. 9 Mile Rd., Detroit 20 (Ferndale), Mich.—12 page booklet—*Automatic deburring machines for a wide variety of parts having different sizes, shapes, and materials are outlined. These include units for deburring spline shafts, motor rotors, plastic cups, molded rubber parts, chain sprockets, die-cast bodies, washers and bushings, spring chamfering, and tubular parts. Notes are also given on selecting the proper deburring tool for each application.

Circle 493 on Page 19

Stationary Air Compressor

*Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa.—24 page catalog—*Model WN-112, a stationary, vertical air compressor is the subject of Bulletin A-62. The compressor is designed for pressures to 125 psi, with piston displacements from 468 to 974 cfm. Photos show typical installations and other photos show the internal construction features. Force-fed lubrication to cylinders and running gear is explained and data are given on three mounting types of drives available with the compressor.

Circle 494 on Page 19

Potentiometers

*Helipot Div., Beckman Instruments Inc., 2500 Fullerton Rd., Fullerton, Calif.—20 page booklet—*Data are given on line of precision potentiometers, associated turns-counting dials, and delay lines. The single-turn and multiturn potentiometers are grouped separately and arranged for a comparison of specifications. Electrical, mechanical, and environmental specifications,

Circle 710 on Page 19

coil data, and outline drawings are included.

Circle 495 on Page 19

Counting & Control Equipment

Freed Transformer Co. Inc., 1705 Weirfield St., Brooklyn (Ridgewood) 27, N. Y.—4 page pamphlet—Data are contained in Catalog 5920 on line of electronic counting and control equipment. Some of the types include totalizing counters for large total count capacity, preset counters for control applications, preset interval generators for timing applications, and modular counters for automatic control applications.

Circle 496 on Page 19

Air & Hydraulic Cylinders

Sheffer Corp., 326 W. Wyoming Ave., Cincinnati 15, Ohio—10 page bulletin—Air and low pressure hydraulic cylinders, rated at 150 psi air and 250 psi hydraulic operating pressures, are outlined in Bulletin 559. Dimensional drawings are shown and charts list bore sizes. Specifications on mounting accessories are also given.

Circle 497 on Page 19

Transistor Digital Circuits

Epsco, 588 Commonwealth Ave., Boston 15, Mass.—8 page bulletin—Data are given on transistor digital circuits, which are suitable for digital equipment, transistor and diode logic circuits, amplifiers, time pulse generators, and visual indicators. Tables list the load type, and the number and type of different loads the circuits can drive. Wiring diagrams show typical applications of the units, designated Series S100.

Circle 498 on Page 19

Centrifugal Pumps

G & H Products Corp., 5718 52nd St., Kenosha, Wis.—16 page booklet—Base mounted and motor mounted centrifugal pumps are described in Catalog PC-759. Principle of operation is explained and details are offered on how to select the proper size pump. Also included are pump dimensions, capacity and friction loss charts, and fluid viscosity tables.

Circle 499 on Page 19

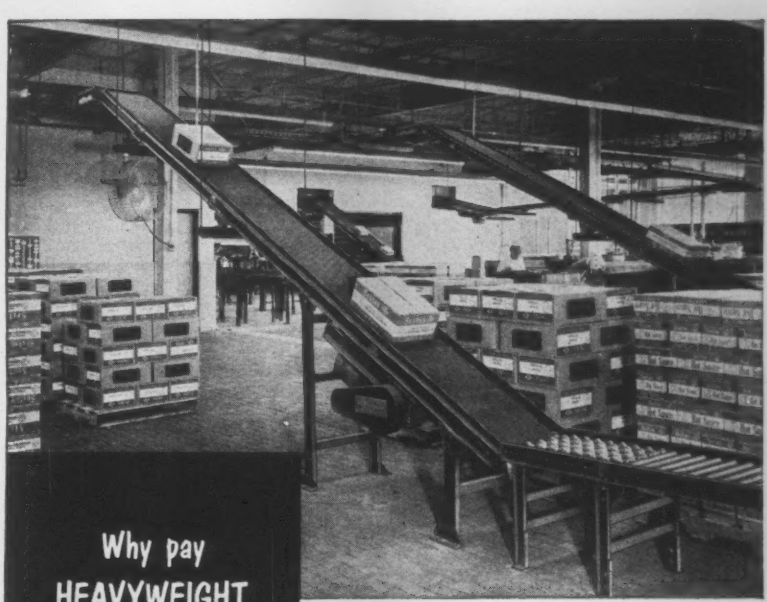
Nonlinear Control System

Donner Scientific Co., 888 Galindo Rd., Concord, Calif.—4 page pamphlet—Bulletin #1, entitled "How to Simulate a Nonlinear Control System with an Analog Computer" covers analog computer techniques and applications. Schematic diagrams of a typical control system are given and plots show the response of a system at various points, with different parameters.

Circle 500 on Page 19

Electrical Components

Ohmite Mfg. Co., 3630 Howard St., Skokie, Ill.—32 page catalog—Specifications, dimensions, and electrical characteristics are given in Catalog 30 for rheostats, potentiometers, resistors, relays, variable transformers, tap switches, chokes, and capacitors. Data are also included on



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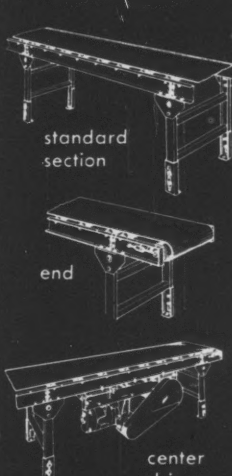
*Use Buschman "LM" Series**



***L**ight-to-**M**edium Belt Conveyors

PRODUCE MORE . . . FOR LESS on Buschman CONVEYORS

Cut Costs with Belt Conveyors by BUSCHMAN

Minimize your equipment outlay! You get the most economical belt conveyor . . . Horizontal, Inclined or Elevated . . . when you use Buschman designed components customized to your particular needs.

Save valuable floor space! Trouble-free design cuts your maintenance costs—saves floor space—enables you to "center" conveyor drives or locate them optionally at either end. Adjustable end pulleys permit easy belt tracking with minimum adjustment.

Integrate your conveyor operations! Lightweight Buschman L.M. Belt Conveyors—portable and stationary—enable you to incorporate automatic controls for highest efficiency in minimum space.

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THE E. W. BUSCHMAN CO.
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Circle 711 on Page 19

CYLINDERS

the sizes you need to save space and money!

Never before available! Precision-built cylinders, with bore sizes as small as ½", do the same work as larger bore size cylinders, eliminate costly waste space and permit actuation never before feasible in confined areas. Reduced overall dimensions insure easier, less expensive installation. Rated at 5,000 psi, Oil-Dyne cylinders may be used at lower pressures to provide even greater savings. ½" to 4" bore sizes; stroke lengths to 72"; complete line of mountings. Write for new cylinder catalog.

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- PUMPS
- CYLINDERS
- PRESSURE SWITCHES
- VALVES
- ACCESSORIES

OIL-DYNE INC.

2115E West Marquette Road, Chicago 36, Ill.

Circle 712 on Page 19

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Series 80,000

FEATURES ONE-PLANE PRESENTATION

Series 80,000
In-Line Display
Shown With Series
10,000 For Comparison in Size

Easily viewed from over 100 feet away when a single digit or letter is used its full size of 3¾" high!

DESIGNED FOR FAST EASY READING OF
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- Display boards
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Price Per Unit $33.00

Quantity Prices On Request

Write Today for Complete Specifications

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Circle 713 on Page 19

miscellaneous items such as rheostat tandem coupling kit, adjustable lugs, parasitic suppressor, mounting brackets, and dial plates and knobs.

Circle 501 on Page 19

New Standard Inch

Pratt & Whitney Co. Inc., Charter Oak Blvd., West Hartford 1, Conn.—8 page bulletin—Bulletin 629, entitled "The New International Inch," discusses the problems that can be encountered with the changeover to the international inch. It is explained how to evaluate machining and measuring operations, and charts show whether or not the difference between the old and new inches will be significant for a particular job of specific dimensions and tolerances. A series of questions and answers covers the immediate points that might concern most manufacturers. Also included are the reasons for adopting the new standard and the benefits that can be derived from it.

Circle 502 on Page 19

Overhead Handling Equipment

Louden Machinery Co., Fairfield, Iowa—52 page handbook—Line of monorail and crane equipment is described and notes are given on how to plan and select an overhead material handling system. Installation photos show automotive, chemical, fabricated metals, food processing, maintenance and power house, paper, rubber, and steel and wire industry applications.

Circle 503 on Page 19

Automatic Lathes

Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.—26 page catalog—Data are contained in Catalog 1213 on automatic hydraulic lathes which are suitable for continuous operation in a mass production plant, or for a wide variety of parts produced in small lots. Details on the features of the machines are given, aided by illustrations. Floor plan diagrams and spindle speed charts are included.

Circle 504 on Page 19

Flow Control Servo Valves

Moog Servocontrols Inc., East Aurora, N. Y.—8 page bulletin—Mechanical feedback electrohydraulic servo valves, designated Series 31 and 32, are described in Catalog 310. Principle of operation is explained, aided by a cutaway photo of the valve. Installation diagrams, performance characteristics, and a glossary of servovalve terminology are included.

Circle 505 on Page 19

Data Processing Systems

Communications & Control Div., Franklin Electronics Inc., Van Nuys, Calif.—4 page pamphlet—Company's facilities for designing and producing data processing systems and components are discussed in Bulletin CC-220. Block diagrams of data systems, language translators, and a general purpose data logging system are included. Notes are also given on digital instruments and accessories.

Circle 506 on Page 19

Package Strapping

Signode Steel Strapping Co., 2600 N. Western Ave., Chicago 47, Ill.—48 page catalog—Catalog 19, entitled "Better Ways to Package, Unitize, and Ship" covers methods to improve packaging and shipping in all industries. Points covered include freight bracing methods, freight car doorway protection, and methods of tensional steel strapping. Data are given on line of strapping, tools, and equipment.

Circle 507 on Page 19

Rotary Air Products

Gast Mfg. Corp., Benton Harbor, Mich.—12 page booklet—Data are contained in Bulletin APP-459 on air motors, air compressors, and vacuum pumps. The air motors can be used to power conveyor belt drives, liquid pump drives, agitators, mixers, etc. Applications for the compressors include: Atomizing liquids, conveying materials, and air-cooling heating. Vacuum pump applications include: Feeding parts, vacuum forming, and leak testing. Schematic diagrams help explain the different uses.

Circle 508 on Page 19

Tempered Glass Pipe

Kimble Glass Co., Subsidiary, Owens-Illinois Glass Co., Toledo 1, Ohio—16 page booklet—Tempered glass pipes and fittings described are applicable in the chemical, food, dairy, pulp and paper, and plating industries. Photos show the different styles available and tables list the sizes. Notes are included on flanges, gaskets, and other accessories.

Circle 509 on Page 19

Rotating Unions

Deublin Co., 1919 Stanley St., Northbrook, Ill.—20 page booklet — Rotating unions for water, steam, air, vacuum, and coolant service are described. Data are given on one-way flow; two-way flow; double-passage applications, rotating siphon pipe unions; and in-the-shaft mountings. Notes are given on rotary coolant inductors for gun drills, oil hole drills, and deep hole drilling. Installation and lubrication instructions are also included.

Circle 510 on Page 19

Analog-To-Digital Recorder

Fischer & Porter Co., 151 Jacksonville Rd., Hatboro, Pa.—8 page bulletin—Analog-to-digital recorder described in Catalog 35-1541 converts and records analog values in digital binary-decimal punched tape form and at the same time provides digital values in electrical form for telemetering, or for any other purpose desired. Features and principle of operation are explained and sketches show the three types of application.

Circle 511 on Page 19

Indicating Flowmeters

Seico Instrument Div., Eclipse Fuel Engineering Co., Rockford, Ill.—18 page booklet—Line of flowmeters, flowswitches, and manometers for measurement of liquid and gas flow is described. Data are given on material composition of all components, maximum application temperatures and pressures, direction of flow, pipe connection locations, and mounting methods. Prices and ordering instructions are included.

Circle 512 on Page 19

Paper Tape Reader

Bendix Computer Div., Bendix Aviation Corp., 5630 Arbor Vitae St., Los Angeles 45, Calif.—2 page pamphlet—Paper tape reader, designated Model PR-2 and used in combination with a general purpose digital computer, is described. The photoelectric reader accepts paper tapes punched in any numeric code. Operation and features of the unit are explained.

Circle 513 on Page 19

Variable-Speed Pulleys

T. B. Wood's Sons Co., Chambersburg, Pa.—12 page booklet—Data are contained in Bulletin 4101 on five variable-speed pulleys designed for ratings of 2, 3, 5, 10, and 15 hp. Features of the design, which eliminate freezing and sticking of the movable flanges, are described. Charts list specifications and notes are also given on motor bases.

Circle 514 on Page 19

Sectional Belt Conveyors

Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.—40 page catalog—Line of sectional belt conveyors in belt widths of 18, 24, 30, and 36 inches is described in Book 2779. Details are given on the procedure for selecting the proper conveyor for an installation. Points covered in this section include: Belt width and speed, proper idler and spacing, structures, and belts. Charts list capacities, terminal group ratings and dimensions, and vertical automatic gravity takeup selection and dimensions.

Circle 515 on Page 19

Packaging Springs

Associated Spring Corp., Bristol, Conn.—12 page booklet—A service designed to have springs, wire forms, and small stampings custom-packaged for better handling, storage, and dispensing, is described. Illustrations show how open coiled springs, special ends and hooks, bends, irregular forms, and stampings can be packaged to eliminate tangling during shipment or unpacking.

Circle 516 on Page 19

Marking Equipment

Markem Machine Co., Keene 45, N. H.—12 page booklet—Data are given on equipment for marking various types of electrical and electronic products such as coil forms, diodes, panels, rectifiers, and solenoids. Machines for legend marking, color banding, screen process printing, tape and label printing, and wire and tube marking are described. Notes are also given on how the marking surface and desired imprint characteristics (color, drying, speed) determine which ink should be used.

Circle 517 on Page 19

Instrument Components

PIC Design Corp., 477 Atlantic Ave., East Rockaway, L. I., N. Y.—416 page catalog—Data are contained in Catalog 20 for over 10,000 items, including gears, shafts, collars, couplings, speed reducers, and differentials. Prices, ordering instructions, and numerous engineering drawings are included. Other sections deal with breadboard kits, precision tool components, and technical data.

Circle 518 on Page 19

Electric Weighing Systems

Gilmore Industries Inc., 13015 Woodland Ave., Cleveland 20, Ohio—12 page booklet—Electric weighing systems for tanks, bins, hoppers, conveyors, cranes, and platforms are described in Bulletin W-100. Diagrams show typical load cell installations and examples are given on how strain gage load cell weighing systems can be used to indicate, record, or control the weights of solids or fluids.

Circle 519 on Page 19

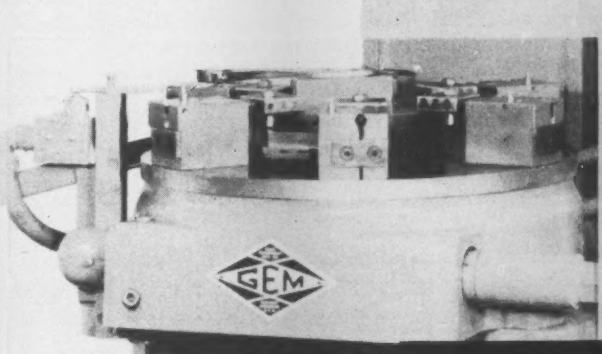
Automatic Filling Scales

Thayer Scale Corp., Thayer Park, Pembroke, Mass.—4 page pamphlet—Ten types of automatic filling scales are outlined, with features and applications noted. Operational diagrams of a belt feeder, rotary feeder, and gravity feeder scale are given.

Circle 520 on Page 19

precision indexing to ±0.001"

...WITH GEM-17 DIAL INDEX TABLE



GEM-17 mounted on GEM ATP-6, 6 ton toggle press with standard GEM base.

Fast—Geneva motion smoothly positions in speeds up to ½ sec.

Rugged—1000 lb. work load with solid anvil capacity of 30 tons.

Positive lock—Bolt in Geneva slot cammed both in and out given positive locking.

Power—Comes complete with rotary air motor, solenoid valve with limit switch (fluid or electric motors available).

Number of stations—6, 8 or 12 standard, 3 and 4 skip.

Size and weight—200 lbs. complete with 17" dia. table (plates up to 36" available).

Geneva Motion GEM-17 Indexing Table standardizes automation on your assembly and machining operations . . . drilling, tapping, riveting, spinning, staking, knurling, chamfering, welding, screwdriving, stud driving and gaging to the speed and accuracy required. Gray's complete engineering staff can adapt the table to your work problem.

Send for Bulletin DI-17 and complete information.

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Circle 714 on Page 19

AUTOMATION abstracts

ADJUSTABLE SPEED CONTROL WITH MODIFIED KRAEMER DRIVES

By F. W. DUNCAN
GMC Truck and Coach Div.
General Motors Corp.
Pontiac, Mich.

ADJUSTABLE SPEED drives are used throughout the automotive industry for a variety of applications. Typical uses include powering grinders, lathes, and transfer devices. Different applications of such drives usually require different combinations of operating characteristics and control features. Some of the considerations involved in selecting adjustable speed drives will be discussed, and a drive that is adaptable to a variety of production applications will be described.

Grinder Drive Requirements

In applying adjustable speed drives to grinders, the following points are important from the user's standpoint: 1. Safety from overspeed should be inherent. 2. Good and permanent balance should be inherent. 3. The drive should require minimum floor space. 4. It should require little maintenance. 5. It should be capable of repetitive performance. 6. It should not have reverse bends in the speed-torque curve. 7. Smooth starts should be characteristic. 8. It should provide adequate protection from abrasive dust. 9. It should have good inherent speed regulation, no-load to full-load. 10. High efficiency is required.

In our experience, modified Kraemer drives, which use both ac and dc motors, are ideally suited to grinder applications since they meet all of the requirements listed. Their maximum speed is limited to the synchronous speed of the ac motor employed which affords inherent overspeed protection. Control of less-than-synchronous overspeed will be described later.

We are installing a total of 14 grinders using this type of drive. Ten of the drives are rated at 25 and four at 15 horsepower. All of the drives are for a speed range of approximately 2 to 1. The units shown in *Fig.* 1 are typical. These grinders are used for producing optimum finishes on crankshafts for commercial vehicles. All 14 grinders use totally enclosed, fan cooled drives that employ unit frame construction; that is, the ac wound rotor motor and the dc motor components are on a common shaft with two ball bearings. The drives are belt-connected to the grinders from the ac component ends of their shafts.

A simplified schematic diagram for the modified Kraemer drive is shown in *Fig.* 2. The wound rotor ac component, the dc component, a slip rectifier, and

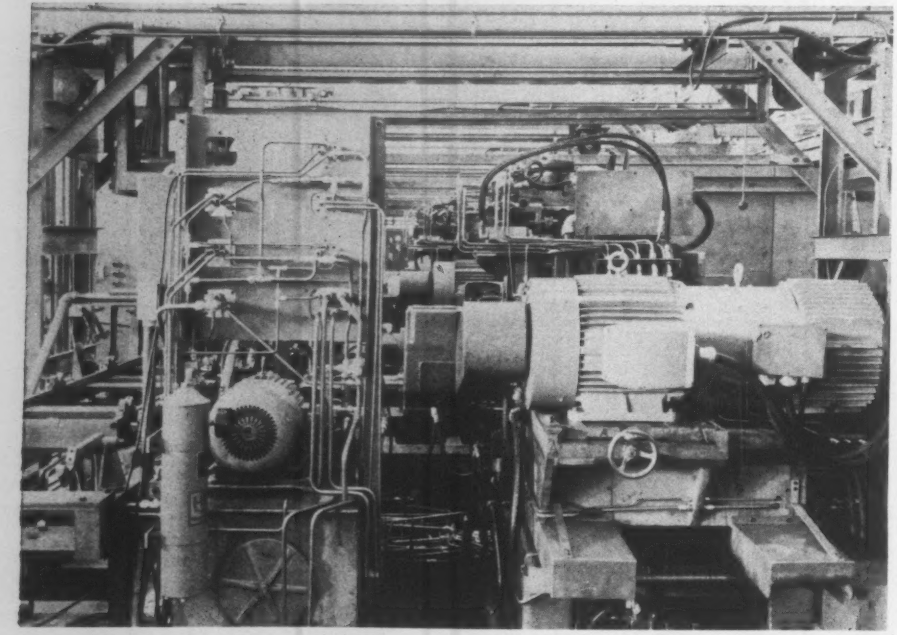
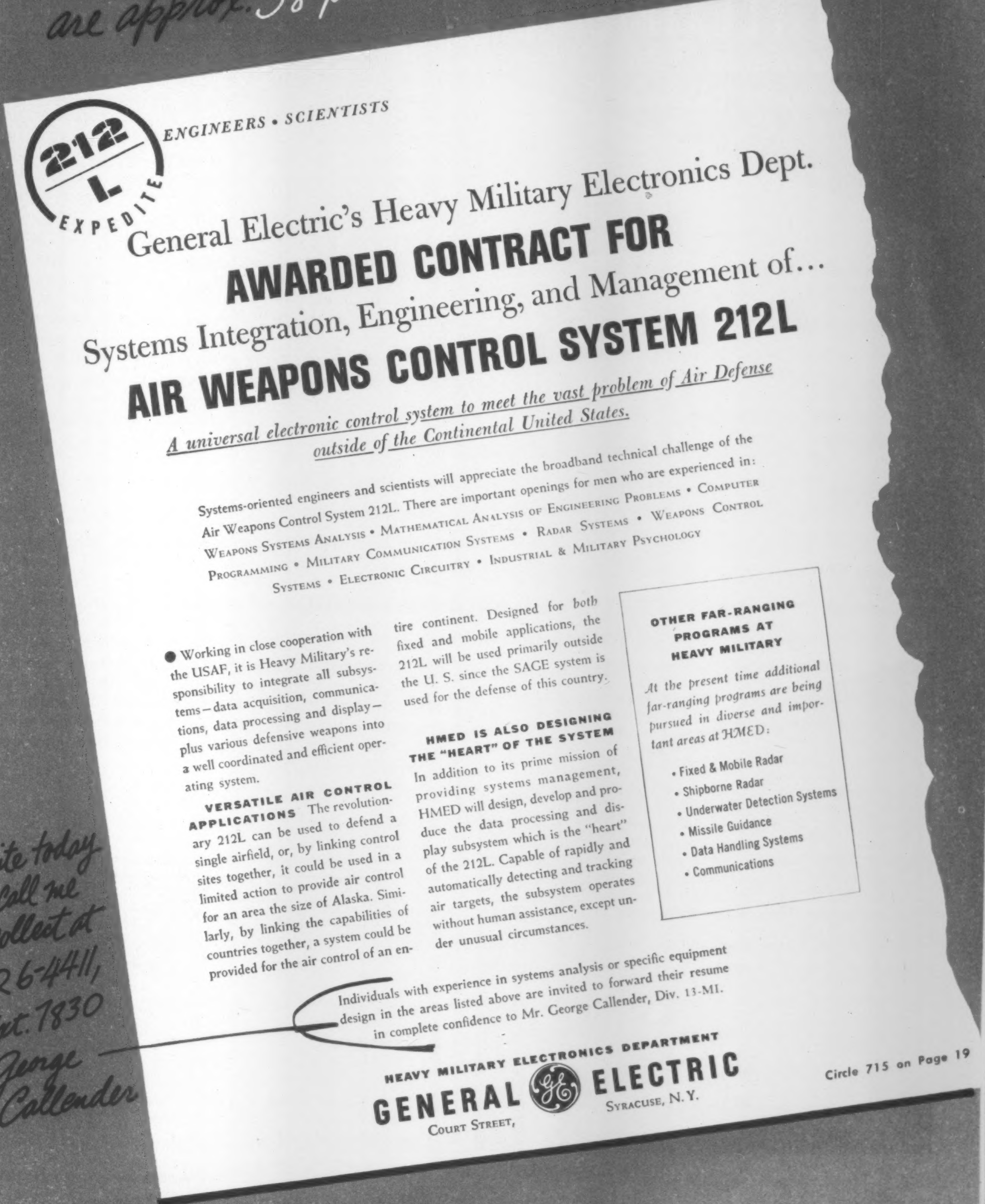


Fig. 1—Bank of crankshaft grinders uses modified Kraemer adjustable speed drives of type seen in right foreground. Each drive unit is totally enclosed and fan cooled. Drives are coupled to grinders by belts.

Since this ad first appeared on June 16th 1959 43 engineers have joined HMED — and there are approx. 38 positions at all levels open now!



212 L EXPEDITE

ENGINEERS • SCIENTISTS

General Electric's Heavy Military Electronics Dept.

AWARDED CONTRACT FOR

Systems Integration, Engineering, and Management of...

AIR WEAPONS CONTROL SYSTEM 212L

A universal electronic control system to meet the vast problem of Air Defense outside of the Continental United States.

Systems-oriented engineers and scientists will appreciate the broadband technical challenge of the Air Weapons Control System 212L. There are important openings for men who are experienced in: WEAPONS SYSTEMS ANALYSIS • MATHEMATICAL ANALYSIS OF ENGINEERING PROBLEMS • COMPUTER PROGRAMMING • MILITARY COMMUNICATION SYSTEMS • RADAR SYSTEMS • WEAPONS CONTROL SYSTEMS • ELECTRONIC CIRCUITRY • INDUSTRIAL & MILITARY PSYCHOLOGY

● Working in close cooperation with the USAF, it is Heavy Military's responsibility to integrate all subsystems—data acquisition, communications, data processing and display—plus various defensive weapons into a well coordinated and efficient operating system.

VERSATILE AIR CONTROL APPLICATIONS The revolutionary 212L can be used to defend a single airfield, or, by linking control sites together, it could be used in a limited action to provide air control for an area the size of Alaska. Similarly, by linking the capabilities of countries together, a system could be provided for the air control of an entire continent. Designed for *both* fixed and mobile applications, the 212L will be used primarily outside the U. S. since the SAGE system is used for the defense of this country.

HMED IS ALSO DESIGNING THE "HEART" OF THE SYSTEM

In addition to its prime mission of providing systems management, HMED will design, develop and produce the data processing and display subsystem which is the "heart" of the 212L. Capable of rapidly and automatically detecting and tracking air targets, the subsystem operates without human assistance, except under unusual circumstances.

OTHER FAR-RANGING PROGRAMS AT HEAVY MILITARY

At the present time additional far-ranging programs are being pursued in diverse and important areas at HMED:

- Fixed & Mobile Radar
- Shipborne Radar
- Underwater Detection Systems
- Missile Guidance
- Data Handling Systems
- Communications

Individuals with experience in systems analysis or specific equipment design in the areas listed above are invited to forward their resume in complete confidence to Mr. George Callender, Div. 13-MI.

Write today or call me collect at GR 6-4411, Ext. 7830 George Callender

HEAVY MILITARY ELECTRONICS DEPARTMENT
GENERAL ELECTRIC
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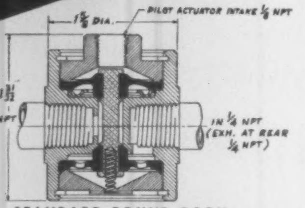
Circle 715 on Page 19

Versatile *Humphrey* "Quick-Dump" Valves Provide

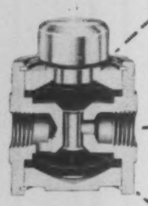
NEW FLEXIBILITY

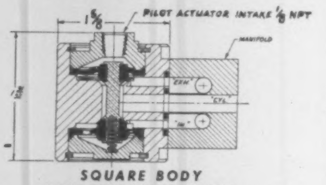
In Designing Pneumatic Controls


1 5/8 DIA.
PILOT ACTUATOR INTAKE 1/8 NPT
CYL. 1/4 NPT
IN 1/4 NPT (EXH. AT REAR 1/4 NPT)

STANDARD ROUND BODY "QUICK-DUMP" VALVE For In-Line Mounting

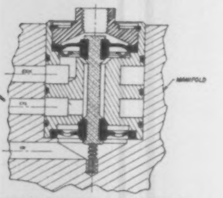
Same Basic Valve Design Used in All Models





SQUARE BODY "QUICK-DUMP" VALVE For Mounting on Manifold

Choice of Manual, Electric, Piloted Operation



NEW CARTRIDGE TYPE "QUICK-DUMP" VALVE For Inserting Internally in Manifold

The basic "Quick-Dump" Valve, small in size, large in capacity, lightning-fast in operation, permits endless variations in body type, methods of mounting, methods of actuating.

There are round, square, cartridge styles; 2-way, 3-way, 4-way; 1/8", 1/4", 1/2" sizes; manual, electric, or pilot-operated. All valve air, oil, water, other liquids, gases to 125 psi. Also vacuum.

Utilizing the flexibility of "Quick-Dump" Valves, Humphrey engineers are producing a continuous flow of new pneumatic controls, both for plant processing and OEM applications.

Your control problem may also lend itself to ready solution through the use of "Quick-Dumps." Consult the Humphrey engineering department.

Complete Line of Standard "Quick-Dumps"

MANUAL
ELECTRIC
PILOTED

Humphrey PRODUCTS DIV.

General Gas Light Co.
KALAMAZOO, MICHIGAN

Specialists in Pneumatic Devices

Circle 716 on Page 19

a field power supply can be readily identified on the diagram. The drive uses resistances in the wound rotor secondary circuit to limit the torque during starting. These resistors are short-circuited by a pneumatic timer at a predetermined time after start up.

The drive can be set for high or low starting torque through the combined actions of the ac and dc motor components and slip resistance. By proper selection of resistance, different values of starting torque may be produced with corresponding low values of ac line inrush current. For example, on a 2 to 1 range drive, starting torque can be approximately 400 per cent with 200 per cent full-load line current.

Speed control is effected by adjusting the field rheostat, hence the excitation to the dc component, as for other adjustable speed dc motors. For the grinders, the speed of the drive is changed automatically for different wheel sizes. A linkage arrangement controlled by the position of the wheel center with respect to the workpiece operates the field rheostat.

Overspeed protection is readily obtained by using a relay having two coils. One of the coils is energized by rectified ac rotor voltage. The other coil receives voltage from an overspeed rheostat mounted on the same shaft as the field rheostat used for speed control. If the base speed should increase, the voltage impressed on the first coil will decrease. Without any change in the speed setting rheostat, however, the voltage across the second coil will remain unchanged. Thus, the total ampere turns for the two relay coils will be less. The relay can be adjusted so that, say, a 10 per cent increase in base speed will allow the relay to drop out and stop the drive.

Lathe Application

We have recently purchased a special lathe to machine crankshafts, for which the modified Kraemer system again affords ideal characteristics. The requirements for the drive are similar to those described for the grinders; that is, it must have good balance (though balance here is not as critical), small mounting space, low maintenance, repetitive performance, no reverse bends in the speed-torque curve, smooth starts, and adequate protection from abrasive dust. In addition, we need a very slow speed and provision for rapid deceleration from high speed to intermediate and low speed and, finally, stopping.

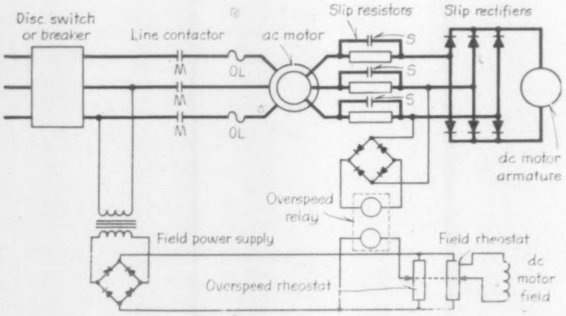


Fig. 2—Simplified schematic diagram illustrates major electrical components used in adjustable speed grinder drives.

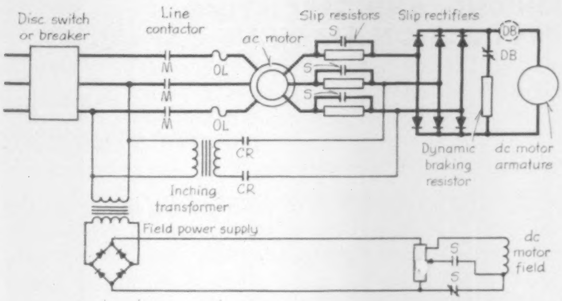


Fig. 3—Circuit of adjustable speed lathe drive includes inching transformer for slow speed operation and dynamic braking resistor for smooth slowing and stopping of drive.

This lathe uses a drive rated 25/50 horsepower, 550/1650 rpm. Although the overspeed circuit used for the grinder application is not needed, two other features are. One of the features is a circuit that gives low inching speed; the other provides dynamic braking for quick slowdown and stopping of the drive.

A simplified schematic diagram of the lathe drive is shown in *Fig.* 3. To provide the low speed for inching, a transformer is used to impress a low ac voltage on the slip rectifier circuit. This low voltage appears as dc across the motor armature. With the primary circuit of the wound rotor component open, and the dc component field energized, the drive will rotate at low speed depending upon the magnitude of the ac voltage introduced to the slip rectifier circuit. For dynamic braking, a resistor is connected across the dc armature with full field applied.

Transfer Device Actuation

Another application which presents a difficult drive problem involves a transfer device that moves workpieces from station to station. The drive is required to start, accelerate to a preset speed, and stop. Two limit switches initiate slowing and stopping actions. Additional interlocks may be used to ensure that the workpieces are in the proper position before an operation can take place.

The maximum speed, and the accuracy of stopping required, vary from line to line. Many lines start and stop 200 to 300 times per hour. In such cases, a drive with a 2 to 1 speed range is adequate. Since stopping must usually be smooth, we are considering the use of modified Kraemer drives for this application.

The modified Kraemer drive is an ac-powered system with the totally enclosed construction desirable for automotive applications. It combines simplicity and high efficiency, and its relatively low inrush current requirements do not impose undue loads on electrical distribution systems. Its characteristics are suitable for many adjustable speed applications in industry.

From a paper entitled "Ac Motor Drives for Adjustable Speed Applications in the Automotive Industry" presented at the 23rd Annual Machine Tool Electrification Forum sponsored by Westinghouse Electric Corp., Buffalo, April 1959.

Something ***NEW*** *you should know about!*

FEEDMATIC-DETROIT AUTOMATED EQUIPMENT

Now, you can speed small parts production and cut costs with new Feedmatic electrically controlled machines. These units automatically and continuously feed, inspect, segregate or assemble parts at greater efficiency . . . reduce handling costs on high volume operations. Use Feedmatic automated machines separately or for high speed delivery to machine tools, heat treating furnaces or final assembly areas.

If your operation involves the manufacture or processing of parts in volume quantities, it will pay you to investigate the cost saving advantages of Feedmatic automated equipment. *Send us your problem today!*

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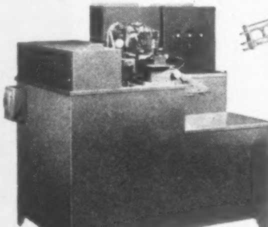
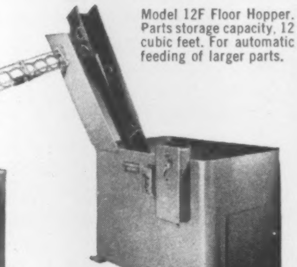
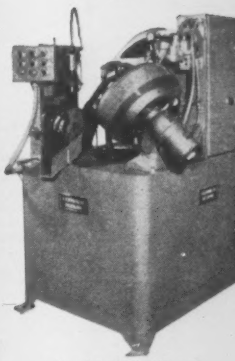


Model 12F Floor Hopper. Parts storage capacity, 12 cubic feet. For automatic feeding of larger parts.



Rotary hopper unit. Fast, efficient parts feeding. Available in sizes from 8" to 24". Feed tracks engineered to meet specific job conditions.



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FULL FLOW VALVES

Flow Control, Needle, Check, for HYDRAULIC Power

Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.

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A complete line: 1/8", 1/4", 3/8", 1/2", and 3/4" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

Model F Standard Flow Control Valve or Model H Needle Valve

Model KF Knob and Dial Flow Control Valve or Model KH Needle Valve.

Model PF Knob and Dial Flow Control Valve or Model PH Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS

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TWO DIRECTION CONTROL

CLOSE CONNECTION

CLOSE CONNECTION

Controlling Double Acting Cylinder

Controlling Single Acting Cylinder

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Circle 717 on Page 19

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. . . THE COMPLETELY NEW AUTOMATIC PARTS WASHER AND METAL CONDITIONING MACHINE

- Labor saving
- Automatic unloading
- For single or multi-stage operations
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Circle 718 on Page 19

FINDING AND SPECIFYING PRODUCTION MACHINE CAPABILITY

By DAVID N. SMITH
Mgr., Research & Development
Jones & Lamson Machine Co.
Springfield, Vt.

THE MEASUREMENT of machine capability applies the science of statistics to process variations. No production process ever produces pieces that are exactly alike; there is always some inherent variability which can never be eliminated. Inherent variations are usually small in magnitude but are large in number. The total amount of basic variability in a given machine tool process depends upon such uncontrollable variables as piece-to-piece hardness, environmental temperatures, minute deflections in the machine, periodic machine vibrations, runout in spindle bearings, etc.

All of these variables combine—in a random manner—to cause small variations in the product. Such variations, therefore, result from a large number of contributory causes, no one of which is comparable to the combined effect of all, and which are just as likely to produce positive as negative deviations from the mean of all the measurements taken. A study of the statistical properties of these variations shows that they follow certain basic laws described by the theory of probability.

A machine tool which is functioning within the mechanical capabilities built into it, and which is not being influenced by assignable causes of variation, will produce parts which show small measurement variations. If a plot is made with measurement deviation from the mean as the abscissa, and the frequency of occurrence of these deviations as the ordinate, the resulting histogram will usually approximate the so-called Normal Distribution Law. A curve fitted to this histogram will be characteristic for a particular process on a specific machine. It is the dimension of this normal curve which defines the machine capabilities.

Specifically, machine capability is defined as the minimum spread of a specific measurement variation which will include 99.7 per cent of all the measurements from the given process. This figure arises from the statistical fact that a spread of ± 3 standard deviations from the mean will include 99.7 per cent of all the measurements, if these measurements are normally distributed about their mean. Therefore, an average of only 3 pieces in 1000 can be expected to have measurements which fall outside these minimum limits. This standard total process width of 6 standard deviations is applied almost universally throughout American industry.

Handling Test Data

In measuring machine capability for a particular process, it is necessary to study the statistical properties of the measurement data and to determine such basic statistics as arithmetic mean, variance, standard deviation, etc. and to make proper corrections in the data so that the final answer will not include any measurement variation for which there is an assignable cause. Various statistical tests are useful in helping to make decisions regarding the presence or absence of assignable causes of measurement variation. These tests must be applied correctly, and to the proper statistical situations, or incorrect conclusions will be drawn from the results.

The objective of a machine capability test should be to arrive at the minimum process width which is defensible for the machine in its present state.

This affects testing. For example, in conducting a machine capability test, it is essential to control carefully the actual test run so that all known causes of measurement variation are eliminated. This means that the pieces to be machined must be uniform with respect to size, material, finish, etc. The machine itself must operate at as uniform a temperature as possible, machine vibrations must be minimized, and no manual adjustments made to the process or machine while the test is being run. In other words, the machine environment must be kept as nearly constant as possible and care must be taken to insure that no known outside disturbances are allowed to affect the machining process.

All measurements should be taken with a gage which has at least one order of resolution higher than that required by the usual run of work from the machine.

Before any computations relating directly to machine capability are made, it is necessary to test the process to see that it is in statistical control. Lack of statistical control throughout the data indicates that assignable causes of measurement variation still exist; that the conditions under which the measurements were taken may be unsatisfactory; and that more careful control of the test is required. In many situations it is necessary to exercise considerable judgment concerning the tests for statistical control because borderline cases may occur.

Machine tool capability tests usually show trends in the data due to known but noncorrectable causes such as tool or diamond wear. Statistical techniques exist for removing such trends from the data.

In a carefully controlled machine capability test where the number of pieces is sufficiently large (not less than 50), it can be assumed that the measurements taken are in themselves representative of a universe of parts. This assumption puts any discussion of the test results in terms of the actual pieces measured. Statistical estimates are then avoided, and the final machine capability measurement is easier to explain and defend.

None of the required calculations for determining machine capability involve anything more than ordinary arithmetic. However, the amount of calculations can become large and therefore it is important to use all the legitimate shortcuts possible in order to reduce the amount of labor.

There are two general situations commonly met in machine capability measurements. The first is the case in which measurement data show no discernible trend. The second case is that where there is a significant trend, as from tool wear. This case is dealt with by correcting the data to remove the trend, that is, by "levelling" the data. This is simply (though tediously) done by fitting a computed trend line to

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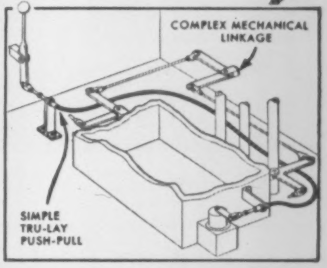

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Circle 719 on Page 19

PNEU-TROL

PNEU-TROL TIME DELAY SWITCH
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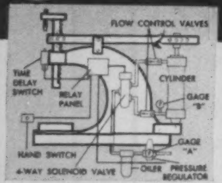
AUTOMATION TIME DELAY SWITCH

FOR CONTROLLED TIME DWELL OF AIR OR HYDRAULIC CYLINDERS



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Circle 721 on Page 19

the raw data by the least-squares method, and correcting each point in the data sequence by the amount of the rise or fall of the trend line at that point. A trend line established by a visual fit is generally not good enough. This procedure eliminates the effects of known assignable causes of variation in the process which we cannot eliminate in actual practice, but which are not a true part of the basic machine performance.

Before a value for machine capability is finally stated, the data must be given several checks for validity. For example, it must be tested for randomness, which includes checking for number of runs above and below the median, number of runs up and down, and mean square successive differences. These tests are described in published texts on statistics. Tests for randomness establish that the machine test was or was not free from disturbances resulting in either long-term trends or short, rapid oscillations. If such disturbances are indicated, an attempt must be made to discover their causes and eliminate them. A rerun of the machine or process is also necessary.

The data should also be checked by preparing control charts for averages and ranges. If all these tests are met, it can be assumed that the data came from a process that was in statistical control. The value of machine capability can then be computed and confidence limits assigned.

Builder and User Benefits

Machine capability techniques are useful to both machine tool builders and users, since their objectives are the same—improved end products from their machines.

The machine tool builder's first concern is in making sure that his product can meet required specifications, and that it will satisfactorily meet competition. But what do we mean by "specifications"? In this case, our interest is not in swing, speed, or horsepower, which are easily and directly measurable. Rather, the criterion is the dimensional quality of workpieces produced. This is just what machine capability expresses —with precision and certainty—making possible the offering of a machine to a customer with assurance that it will meet his requirements.

The machine tool builder is also concerned with improving his product. He hopes a new model will be better than his current model. This can be determined, as far as quality of output is concerned, by the yardstick of machine capability.

As machines become more automated, builders are incorporating features of self regulation in their products. With integral gages, for example, it is possible to continuously measure the dimensions of work produced, apply feedback signals to the machine controls, and thus adjust the tools automatically to compensate for drift and other trends. Systems of this type, to be successful, require exact knowledge of machine capability, sources of possible disturbances, and rates of change of any trends. This imposes on the control system designer an entirely new problem, and lands him squarely in the middle of the machine capability concept.

What can knowledge of machine capability do for the user? His first concern is for buying equipment which will meet his product quality requirements without producing an objectionable percentage of scrap. The machine must also operate at a desired production rate without the need for exceptional operator skills to compensate for machine deficiencies. Finally, he wants a comfortable margin between his workpiece tolerances and the expected performance of the machine.

But the user is also concerned with avoiding "overspecifying" the machine, that is, buying one with a much greater capability than he needs at a correspondingly high cost. Does he need a drill press or a jigborer? Here, a knowledge of machine capability gives both buyer and builder a common language, and a specification tool which will assure each that the best buy is being made.

From the user's standpoint, knowledge of machine capability provides him with another valuable tool. During its useful life, a machine is subject to wear and degradation. If the quality of the product deteriorates to an objectionably low level, a new test for machine capability will tell the user whether the fault lies in the machine or in some change in its mode of operation. In the first case, reconditioning or replacement of the machine would be indicated. In the second case, the user would look for and correct the cause for the deficiency within his own operation, and thus avoid the expense and the interruption of a repair or rebuilding job.

We are currently witnessing the advent of a new type of equipment—numerically controlled machine tools. With these machines, information—generally from punched or magnetic tape—is prepared in an office. The tools are accurately preset before being placed in the machine, and the hope is that the first piece made will be a good piece. But without thorough knowledge of the capability of such a machine system, what chance would there be of achieving this? In fact, the designer of the control system has to have complete knowledge of the machine capability before he can design the controls to meet specifications and have the machine and its controls compatible.

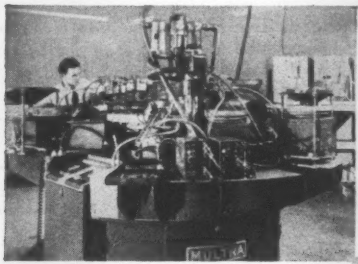
Knowledge of machine capability is of great usefulness to both parties in any subcontracting operation—as a protection to the placer of the subcontract that he will get what he wants at a fair price, and to the bidder so that he can do what is asked of him at a reasonable profit.

Conclusion

Machine capability can thus be looked upon as an extremely useful "common-language" tool; useful to the buyer, the sales engineer, the user, the quality control engineer, and even to the machine operator. We can expect to see it with increasing frequency in purchase specifications and in machine advertising.

From a paper entitled "Machine Capability—A Tool For Builder And User" presented at the 13th Annual Convention of the American Society for Quality Control, Cleveland, May 1959.

WHAT'S YOUR ASSEMBLY PROBLEM?



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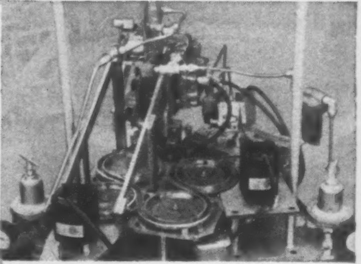

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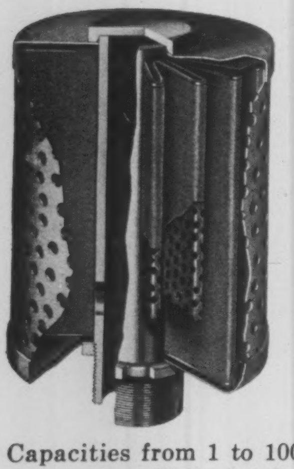

are you stuck?

confidential file

Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 1892-P

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. . . We would like to consider methods or equipment which would enable us to operate the gas burners (kiln dry process for grain) on automatic temperature response. . .

Plant Engineer

CASE 1902-P

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. . . Our problem is affixing a small replica of a photograph record, about the size of a 50-cent piece, to a card in such a way that it can be removed and used. The card is collated with a letter, reply envelope, and brochure and the entire ensemble inserted into a mailing envelope at a rate of approximately 3000 per hour. Who uses or makes an adhesive dispenser that will put a small dot (not a smear) of adhesive on a fixed point? Is it actuated by air or a solenoid? What adhesive will have enough tack as soon as applied to permit the disk to be placed and not have it slide? Who has an application requiring the feeding of disks such as described . . .

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. . . We have a tracing problem. The part is of slow changing contour and approximately 80 feet in length. Cutter head will be positioned 90 degrees to the surface at all times, the critical dimension being rise and fall. Due to varying skin thickness, the part must be traced from the side opposite the cutter. Vibration, chips, and coolant present a problem which requires locating the tracer some distance ahead of the cutter. A delayed signal from the tracer to the servomechanism that drives the cutter head carriage is necessary. Taping of (signals for) the whole surface and then taking the machine cut has been discarded due to temperature changes in such a long length. Our cutter can travel only about 12 ipm since we are cutting stainless steel. We would appreciate any suggestions . . .

Supervisor, Tool Design

SUGGESTIONS FOR 1823-P (June 1959)

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. . . We have done all sorts of pH measurements on the basis of continuous "wet chemical" analyses. In many cases,

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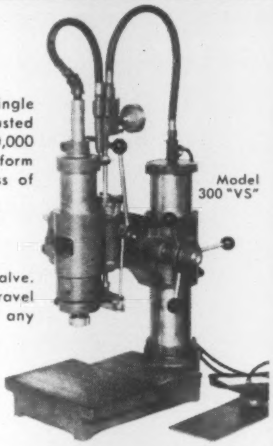
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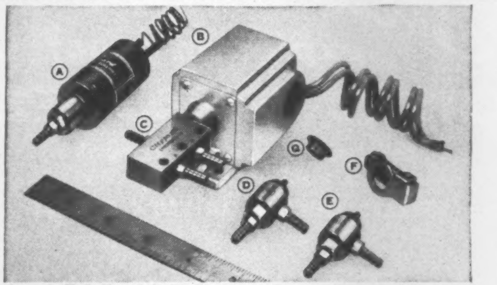

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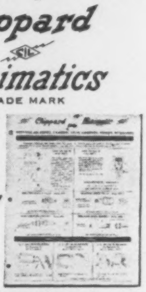

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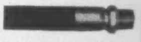
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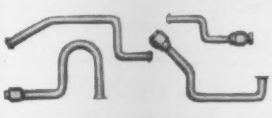
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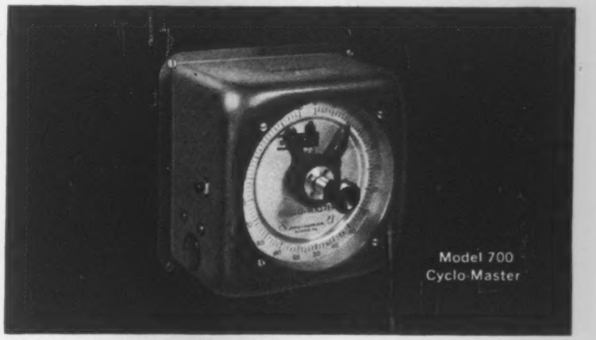
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Circle 728 on Page 19

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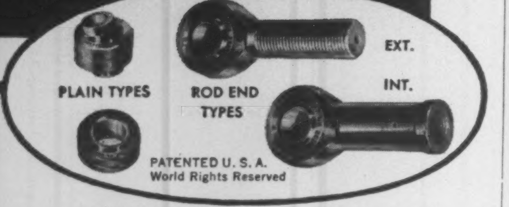

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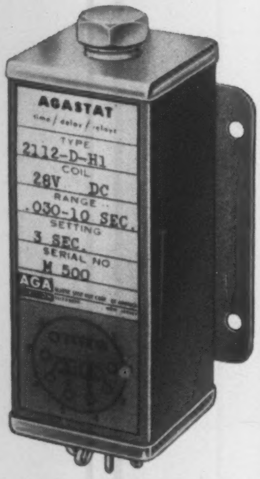

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Circle 732 on Page 19

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D. J. Carter
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SUGGESTIONS FOR 1851-P (JULY 1959)

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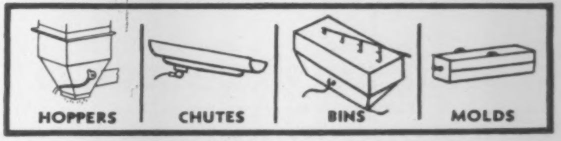

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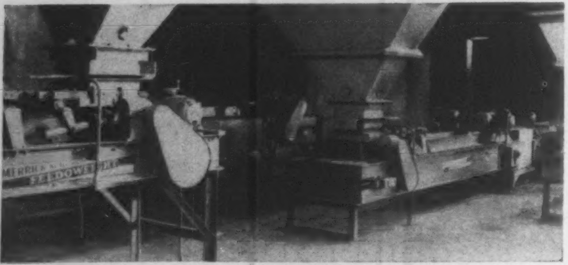

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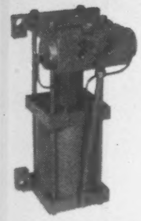

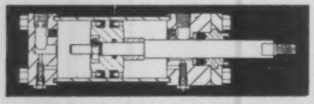

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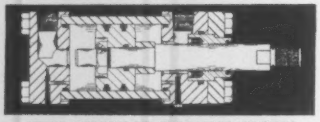

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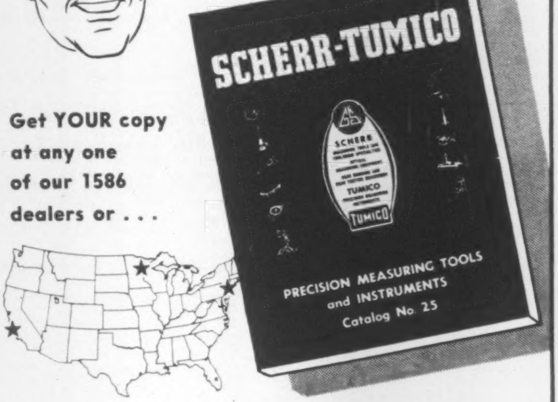

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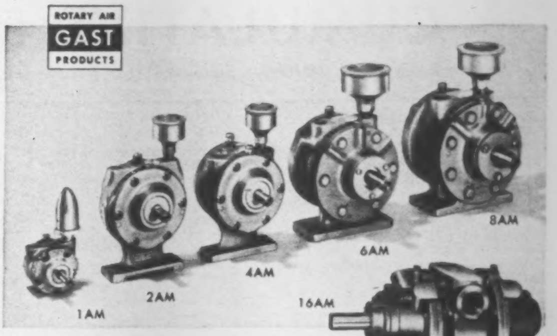

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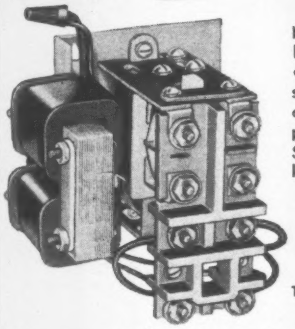

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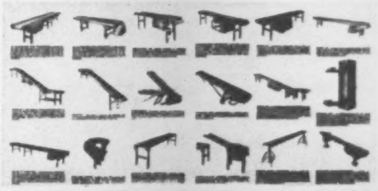

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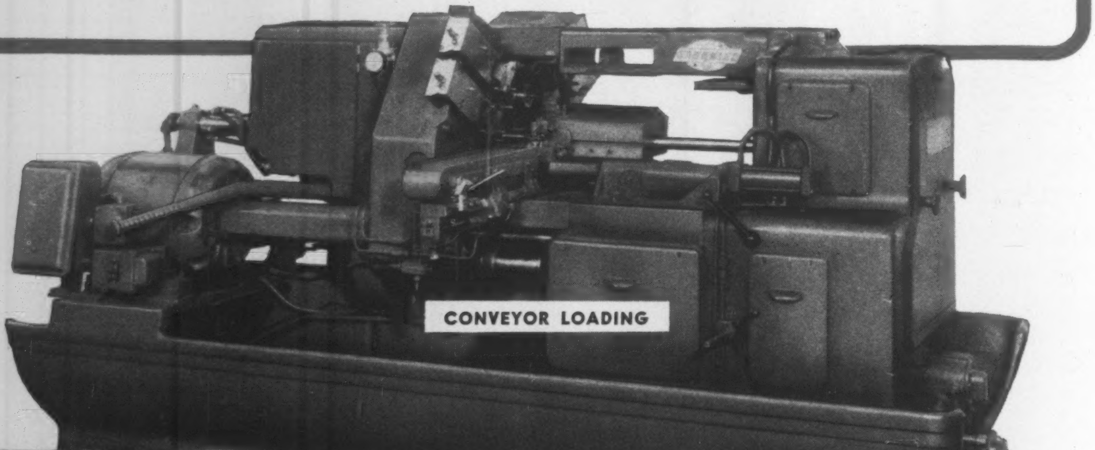

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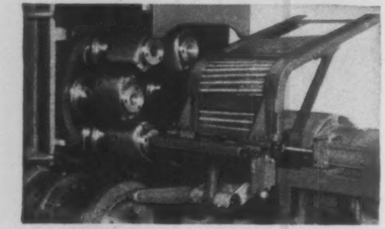
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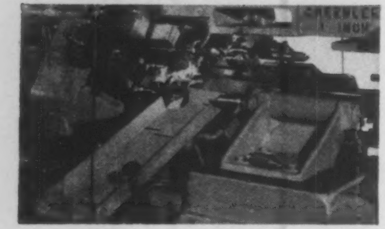
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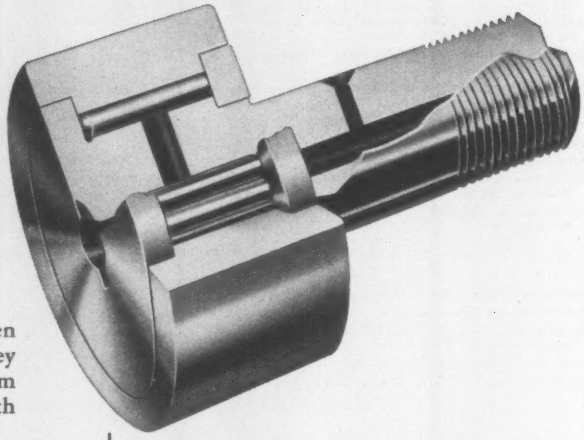

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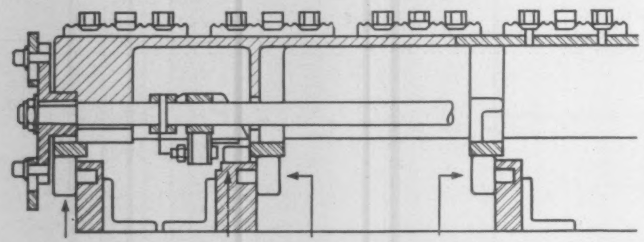

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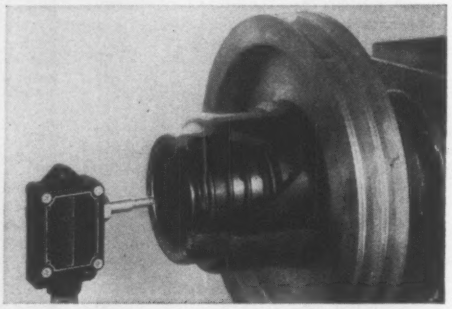

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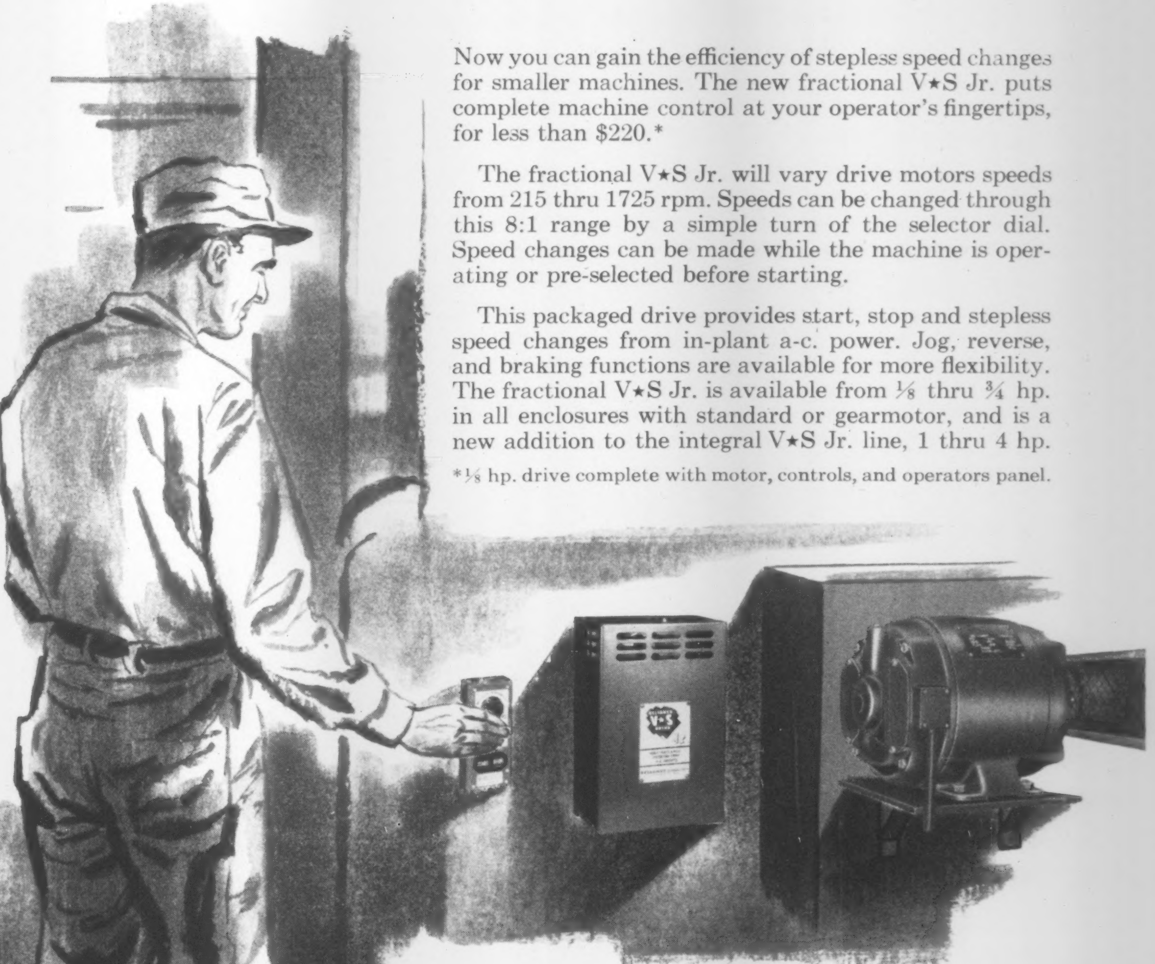

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*⅛ hp. drive complete with motor, controls, and operators panel.

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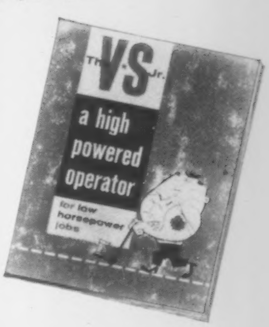

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REEVES

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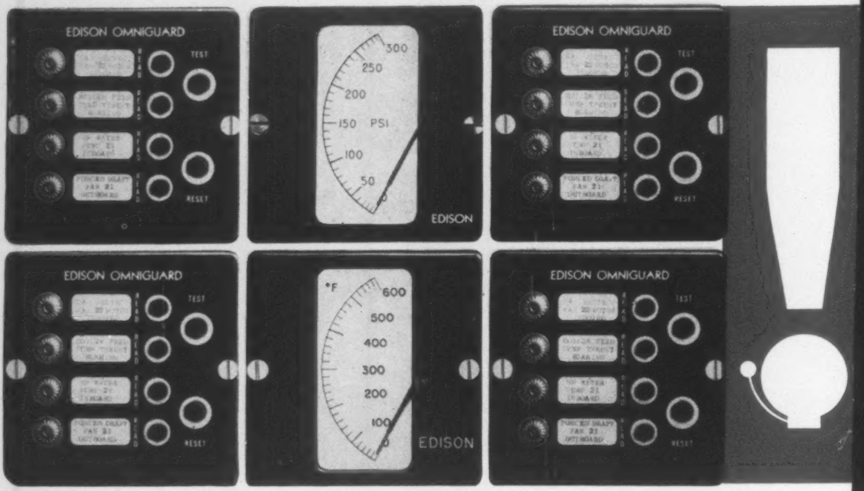

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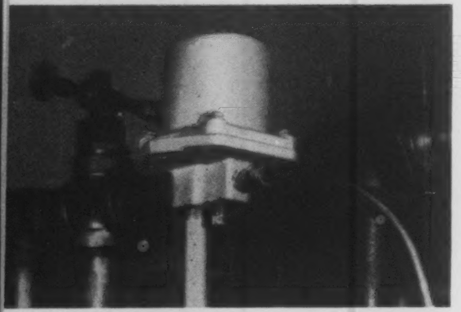
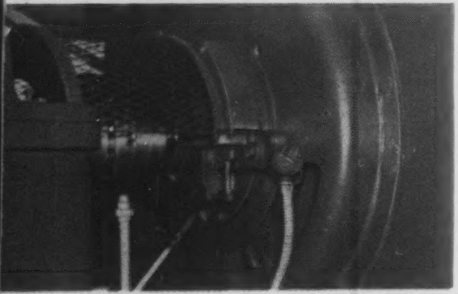


PRESSURE

With the Edison Omniguard system you can monitor gas, fluid or vapor pressure. Heart of the system is a rugged, accurate, pressure detector which converts pressure directly to electrical resistance—requires no millivolt conversion—no amplifier. For pressures under 60 PSI a precision capsule is the sensing element. From 60 to 3000 PSI special burdon tube elements are used.

When pressure changes, resistance varies and this deviation is transmitted to the control panel. Units operate over ambient temperatures of 32° to 150°F. Control panels are available with a wide variety of scales and are equipped with both normally open and normally closed alarm contacts to operate any type of auxiliary device or to automatically shut down machinery or process.

Compact, reliable Resistance Pressure Detector transmits changes in pressure to central control panel.



TEMPERATURE

Edison Omniguard also provides reliable protection from overheating. You can monitor the temperature of bearings, gases and liquids in critical equipments or processes. Reliable Edison Resistance Temperature Detectors have no moving parts and give instantaneous warning when limits are exceeded. Unlike other systems which only scan, Omniguard is continuously monitoring. You can obtain exact readings of temperatures in all parts of your plant from one central control panel.

For greater flexibility and reliability each detector circuit is completely independent. If one circuit is damaged, all other circuits remain "on guard." When changes or additions are required they can be accomplished quickly and easily.

Rugged, accurate Resistance Temperature Detector guards against overheating of this motor bearing.

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McGRAW EDISON

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